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MISA

Municipal/Industrial Strategy for Abatement

SECOND REPORT ON THE MONITORING DATA

FOR THE PETROLEUM REFINING SECTOR

JULY 1990

Ontario

Environment
Environnement

Jim Bradley Minister/ministre

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SECOND REPORT ON THE MONITORING DATA FOR THE PETROLEUM REFINING SECTOR

Report prepared by:
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JULY 1990

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I BACKGROUND

Monitoring data for the Petroleum Refining Sector was collected under Ontario Regulation 695/88 and Ontario Regulation 359/88 as amended to Ontario Regulation 696/88. Monitoring under this regulation began on December 1, 1988 and was completed on November 30, 1989. Following this period, only the daily parameters continued to be monitored under the regulation.

During the monitoring period data were collected by industry under strict protocols to Ministry specifications. The companies were also required to carry out a quality control program to help validate the monitoring data. In addition to flow monitoring and sampling for chemical analyses, the dischargers were required to perform toxicity testing on their process effluents and once-through cooling water.

The Ministry regional staff kept a close check on compliance with the monitoring regulation. They also inspected the plants during the monitoring period and carried out audit sampling. The Ministry's laboratory performed audit sample analyses to verify the analytical data collected by the industry. The Ministry also performed two open scan characterizations on each refinery process effluent to check for potential new contaminants in the Petroleum Refining Sector.

The first report on monitoring data titled "Preliminary Report for the First Six Months of Monitoring in the Petroleum Refining Sector (December 1, 1988 to May 31, 1989)" was published in December 1989.

The second report on monitoring data covers the second six months of monitoring (June 1 to November 30, 1989) for process effluent streams. The data for effluent streams such as once-through cooling water, storm water, landfarm leachate and emergency overflow are provided for the 12 months of monitoring since these data were not presented in the first report. Data on all effluent streams are provided with the same assumptions and in a similar format so that comparisons can be made with the first six month report.

The Ministry is adopting a statistical analysis approach for the final evaluation of monitoring data for use in effluent limits development. Many issues such as the handling of data less than the regulation method detection limit, removal of outliers, use of quality assurance/quality control (QA/QC) data have been defined and resolved by the Ministry in a consultative process with Environment Canada, industry and the MISA Advisory Committee (MAC). The position papers have been released to a selected number of public interest groups and the Ministry will finalize them after the review period. The final database will be summarized (using the methods agreed upon in the

position papers) in the development document for the Effluent Limits Regulation for the Petroleum Refining Sector.

The Joint Technical Committee for the Petroleum Refining Sector has begun work on the development of the Effluent Limits Regulation for the Petroleum Refining Sector.

II PRESENT STATUS OF MONITORING

The Petroleum Refining Sector has completed 12 months of monitoring but continues to monitor for a few parameters on a daily basis. Dialogue between industry and the Ministry continues in order to validate the database as data were sometimes submitted incorrectly. Data provided in this report reflects the database (submitted by the refineries) as of May 31, 1990.

1. Quantity of Analytical Data

A large amount of data has been collected from the refineries in the year of monitoring. Following is the summary for all seven refineries - all data points in the Petroleum Refining Sector - for the period December 1, 1988 to November 30, 1989:

Type of effluent	Number of data points
Process Effluent	35,778
Once-Through Cooling Water	5,725
Storm Water	3,934
Landfarm Leachate	1,368
Emergency Overflow	53
Intake Water (optional-not required by regulation)	14,375
Quality Control	17,872
Total	79,105

2. Preliminary Assessment of the Monitoring Data

A preliminary review of data was done and several tables and figures are attached. A list of remark codes is attached as Appendix A. Appendix B provides a key to the refinery numbers used in the tables and figures.

Since the policies regarding data interpretation are under review, interpretation of the data in this report is of an "interim" nature. The evaluation of the data is based on the same assumptions as in the first report and is as follows:

- **All analytical results with remark codes "< DL", "< T" and "< W" are treated as 0 (zero) i.e. non detected (approximately 44% of the data).**

- **All analytical results with remark codes "<", ">", "A" or without a remark code are included.**

- **All other data with the remark codes different than the ones above are ignored in this review (1.5% of the data), because they represent questionable data.**

- **Quality control and audit data are not considered in this review.**

- **Loadings are calculated as the product of the flow and concentration.**

- **For continuous streams, such as process and once-through cooling water effluent streams, the daily loading (kg/day) of a parameter is calculated by multiplying reported daily flow by daily concentration (arithmetic mean). The values reported are an average of the daily loadings.**

- **For non-continuous streams (event driven discharges), such as storm water, emergency overflow and landfarm leachate, the mass loading (kg) of a parameter is calculated by multiplying the total volume discharged in a month by the average monthly concentration. The values reported represent the sum of all the monthly loadings (i.e. total mass discharged in twelve months of monitoring).**

3. Review of Monitoring Data for Process Effluent Streams

3.1 Concentration Results for Priority Pollutants

Table 1.0 shows the performance of the Petroleum Refining Sector as a whole for process effluent streams. In this table, the parameters and their frequency of occurrence are shown. The total number of parameters identified in the second six months of monitoring for the entire sector is 68 out of 149 parameters for all monitoring frequencies (including characterization).

Tables 2.1 to 2.7 list the parameters identified in the process effluent streams at each refinery.

In the case of Shell Canada Products Limited, the quality of the process effluent reported here should not be considered as the quality of the final effluent because Shell operated under special circumstances during the monitoring year. According to their Certificate of Approval, effluent from the biotreater clarifiers must not be directly discharged if it contains more than 100 mg/L of volatile suspended solids (VSS) or 0.13 mg/L phenols. In this case, it is either diverted to a potentially oily water (POW) separator or a storm water retention pond. Further settling occurs in the separator but evaluation of the data is difficult because the process effluent is combined with large volumes of once-through cooling water. Due to start-up problems with a new clarifier, the process effluent was routed to the POW separator for 64 days between June 1 to November 30, 1989. The process effluent data provided in Table 2.5 lists the priority pollutants found in the effluent after the biotreater clarifiers. Effluent from the POW separator was reported as once-through cooling water even though during abnormal or upset conditions it can contain process effluent.

In the case of Petro-Canada Inc., Oakville and Mississauga plants, the storm water is treated through the biotreater together with the process effluent. Due to this fact the quality of the process effluent is affected during storm events and may show higher total suspended solids than normal (due to washing of silt and clay from area runoff) as well as some compounds that are naturally found in soil (e.g. aluminum).

Routine Monitoring

The monthly average concentrations of selected **daily and thrice weekly** parameters for all seven refineries are shown on Figures 1.1 to 1.7.

Results Compared to OEQO

Although Certificate of Approvals are based on monthly averages as opposed to single day concentrations, all the individual results (not averages) were compared against the existing Ontario Effluent Quality Objectives (OEQO) for Petroleum Refineries (1977). The table below shows the number of refineries exceeding OEQO on at least one day.

Parameter	OEQO	Refineries exceeding
Oil and Grease	10 mg/L	two
Phenols	20 ug/L	four
Suspended Solids	15 mg/L	six
Ammonia	10 mg/L	two
pH	5.5-9.5	none
Chromium	1 mg/L	none
Zinc	1 mg/L	one

Quarterly and characterization analyses identified copper, nickel and lead in concentrations below OEQO for petroleum refineries.

3.2 Flow Data

Table 3.0 and Figure 2.0 show average daily flow data on a monthly basis for process effluent for all seven refineries.

3.3 Loadings

Loadings for daily and thrice weekly parameters for all seven refineries are listed in Table 4.0. Figures 3.1 to 3.7 show loadings for selected daily and thrice weekly parameters.

3.4 Toxicity Testing

Of the 42 samples that were tested with rainbow trout for the entire sector, only one out of six samples at the Petro-Canada refinery in Oakville did not pass the toxicity test. Chemical analysis of a sample collected on the same day showed that it was highly probable that the concentrations of zinc and un-ionized ammonia in the effluent were contributors to the observed lethality in the laboratory tests.

Of the 43 effluent samples that were tested for toxicity to Daphnia magna for the entire sector, only one out of six samples at Petro-Canada Inc., Lake

Ontario Refinery, Oakville Plant and one out of six samples at Petro-Canada Inc., Lake Ontario Refinery, Mississauga Plant did not pass the toxicity test. At the Oakville plant aluminum, chromium, unionized ammonia, and oil and grease were measured at levels which caused the observed lethality to Daphnia in laboratory tests. A sample of process effluent from the Mississauga refinery had high concentrations of aluminum and chromium, and moderately high levels of zinc which may have contributed to the toxicity of the sample to Daphnia.

Six samples were tested for toxicity to rainbow trout and Daphnia magna at each of the refineries. A summary of the toxicity results are provided below:

	Number of Failed LC_{50} tests	
	Rainbow trout	Daphnia magna
Esso Petroleum Canada (Sarnia)	none	none
Petro-Canada Inc. (Mississauga)	none	1 of 6
Petro-Canada Inc. (Oakville)	1 of 6	1 of 6
NOVA Petrochemicals Inc.	none	none
Shell Canada Products Limited	none	none
Suncor Inc.	none	none
Esso Petroleum Canada (Nanticoke)	none	none

Further information on the toxicity results can be found in the Ministry document titled "Acute Lethality Data for Ontario's Petroleum Refinery Effluents covering the period for June 1989 to November 1989".

4. Review of Monitoring Data for Once-Through Cooling Water, Landfarm Leachate, Storm Water and Emergency Overflow Effluent Streams

Tables listing concentration, flow and loadings are provided in Appendix C for once-through cooling water effluent streams and intake water. Intake water is provided as net loadings may be considered in the final evaluation for once-through cooling water effluent streams.

Tables listing concentration, flow and mass loadings are provided in Appendices D, E and F for landfarm leachate, storm water and emergency overflow effluent streams respectively. The volume of effluent discharged and the discharge duration are provided for these streams because they are event driven. The loadings reported are the total mass loading for the twelve month monitoring period.

None of the nineteen samples collected from the cooling water effluents were acutely lethal to trout. Of the seventeen samples that were tested with

Daphnia magna, none were acutely lethal. Toxicity testing was not required for the other streams.

III CONCLUSIONS

The preliminary review of QA/QC data indicates that the monitoring database is satisfactory for use in setting the effluent limits for the Petroleum Refining Sector.

The number of parameters detected across all seven refineries in the first six months was 69 parameters compared to 68 found in the second six months, of which 15 parameters are conventional parameters. The first characterization identified one dioxin compound while the second characterization detected four dioxin/furan compounds all below the Ministry of the Environment Interim Petroleum Effluent Guideline (December 1988) of 15 ppq 2,3,7,8 TCDD toxic equivalents. Polychlorinated Biphenyls (PCBs) were not found in the second characterization.

The number of refineries exceeding OEQOs was reduced in the second six months as compared to the first six months of monitoring.

The findings of the MISA monitoring program have instigated some projects for improvement of the effluent quality. During the monitoring year there have been some changes made by the refineries in their treatment processes.

- NOVA Petrochemicals Inc. has changed from using chromium-zinc based additives to phosphorus based additives to their cooling water which has resulted in reduced concentrations of chromium and zinc while the concentrations of phosphorus remained below the allowable limit.

- Petro-Canada Inc., Lake Ontario Refinery - Oakville Plant will eliminate the use of chrome/zinc as a corrosion inhibitor in July, 1990. A comparison of zinc concentrations from the first six months versus the second six months of MISA monitoring reveals lower concentrations during the second six months. This is a result of improved chemical injection management. The refinery also started a self-initiated program to improve their wastewater treatment plant in 1987 which was approved by the Ministry in 1988. Construction activities continued throughout the MISA monitoring program. The modifications were officially commissioned in January 1990. The upgrade to their effluent treatment system included installation of a new clarifier, sand filter and settling pond. A charcoal filtration system will be added to treat dioxin contaminated regenerator washwater. A sampling program was also initiated on the final refinery effluent and storm water to identify the source of furans and dioxins.

- Shell installed a third clarifier in December 1988 in order to reduce suspended solids in the final effluent.

TABLE 1.0
PROCESS EFFLUENT STREAMS
CONVENTIONAL AND PRIORITY POLLUTANTS FOUND AT
ALL SEVEN REFINERIES

PARAMETER	N.	F.O.	MIN	MAX	AVG	UNIT
COD	43	100	8.000	119.000	46.535	mg/L
DOC	547	100	.000	256.000	13.138	mg/L
Hydrogen ion (pH)	1265	100	6.400	9.200	7.722	
Nitrate+Nitrite	43	100	.039	13.900	3.472	mg/L
Specific conductance	44	100	515.000	2,870.000	1,492.045	uS/cm
TOC	475	100	.000	308.000	20.011	mg/L
Total suspended solids	800	100	.000	792.000	23.843	mg/L
Total Kjeldahl nitrogen	46	98	.000	9.600	1.947	mg/L
VSS	1263	97	.000	504.000	13.003	mg/L
Zinc	326	96	.000	15,390.000	143.403	ug/L
Total phosphorus	550	93	.000	4.100	.475	mg/L
Aluminum	47	91	.000	2,700.000	306.340	ug/L
Phenolics (4AAP)	1263	91	.000	140.000	9.136	ug/L
Arsenic	47	81	.000	34.000	9.313	ug/L
Ammonia plus Ammonium	605	79	.000	70.000	1.738	mg/L
Cyanide Total	43	79	.000	.023	.007	mg/L
Sulphide	613	77	.000	.870	.087	mg/L
Chromium	321	74	.000	390.000	86.647	ug/L
Oil and grease	604	72	.000	18.700	2.030	mg/L
Selenium	47	64	.000	24.000	5.123	ug/L
Chromium (hexavalent)	6	50	.000	14.000	5.167	ug/L
Molybdenum	47	49	.000	40.000	10.255	ug/L
Nickel	47	49	.000	30.000	4.085	ug/L
Antimony	47	34	.000	9.000	.628	ug/L
Vanadium	47	34	.000	140.000	13.438	ug/L
Chloroform	43	33	.000	14.600	.952	ug/L
Copper	47	30	.000	140.000	4.815	ug/L
Bis(2-ethylhexyl) phthalate	16	25	.000	3.070	.632	ug/L
Cadmium	47	21	.000	3.000	.180	ug/L
Chloromethane	43	19	.000	10.000	.971	ug/L
Methylene chloride	43	19	.000	33.000	1.187	ug/L
Benzylbutylphthalate	17	18	.000	12.000	.871	ug/L
Hexachlorobenzene	6	17	.000	.100	.029	ug/L
Octachlorodibenzo-p-dioxin	6	17	.000	.071	.020	ng/L
Octachlorostyrene	6	17	.000	.140	.040	ug/L
Total H7CDD	6	17	.000	.040	.007	ng/L
Total PCDF	6	17	.000	.024	.007	ng/L
Total TCDF	6	17	.000	.065	.019	ng/L
Toluene	548	16	.000	38.300	.400	ug/L
Lead	47	13	.000	40.000	1.898	ug/L
Thallium	47	13	.000	20.000	2.383	ug/L
1,1-Dichloroethylene	43	12	.000	2.170	.180	ug/L
Benzene	548	12	.000	55.400	.346	ug/L
Bromomethane	43	12	.000	19.800	1.321	ug/L
Di-n-butyl phthalate	17	12	.000	1.200	.135	ug/L
o-Xylene	548	12	.000	20.500	.366	ug/L
m-Xylene and p-Xylene	548	11	.000	43.410	.525	ug/L
Chrysene	43	9	.000	3.000	.155	ug/L
Indeno(1,2,3-cd)pyrene	43	9	.000	10.000	.718	ug/L
Mercury	47	9	.000	.150	.009	ug/L

(Table 1.0 continued on next page)

N. = number of analyses
F.O. = frequency of detection above the laboratory method detection limit (%)
MIN = minimum concentration
MAX = maximum concentration
AVG = average concentration in the period June 1 - November 30, 1989
UNIT = unit of measurement
▒▒ = conventional pollutant

TABLE 1.0 (continued)
PROCESS EFFLUENT STREAMS
CONVENTIONAL AND PRIORITY POLLUTANTS FOUND
IN ALL SEVEN REFINERIES

PARAMETER	N.	F.O.	MIN	MAX	AVG	UNIT
1,1-Dichloroethane	43	7	.000	.370	.023	ug/L
Benz(a)anthracene	43	7	.000	3.000	.209	ug/L
Benzo(a)pyrene	43	7	.000	6.000	.419	ug/L
Benzo(b)fluoranthene	43	7	.000	4.000	.279	ug/L
Benzo(g,h,i)perylene	43	7	.000	10.000	.698	ug/L
Benzo(k)fluoranthene	43	7	.000	6.000	.419	ug/L
Dibenz(a,h)anthracene	43	7	.000	10.000	.698	ug/L
Perylene	43	7	.000	6.000	.419	ug/L
Pyrene	43	7	.000	.630	.039	ug/L
Cobalt	47	6	.000	6.000	.277	ug/L
1,2-Dichloroethane	43	5	.000	.300	.012	ug/L
1,2-Dichloropropane	43	5	.000	27.000	.719	ug/L
2,4-Dimethylphenol	43	5	.000	8.140	.346	ug/L
1,1,2-Trichloroethane	40	3	.000	.860	.022	ug/L
Ethylbenzene	548	3	.000	3.180	.024	ug/L
4-Nitrophenol	43	2	.000	1.600	.037	ug/L
Phenanthrene	43	2	.000	.640	.015	ug/L
Phenol	43	2	.000	1.900	.044	ug/L

NOTE: The number of analyses for a parameter in Table 1.0 will not necessarily be equal to the sum of the number of analyses of the individual refineries (Tables 2.1 - 2.7). Parameters are not listed in Tables 2.1 - 2.7 if all values are less than the laboratory method detection limit.

N. = number of analyses
F.O. = frequency of detection above the laboratory method detection limit (%)
MIN = minimum concentration
MAX = maximum concentration
AVG = average concentration in the period June 1 - November 30, 1989
UNIT = unit of measurement
= conventional pollutant

TABLE 2.1
PROCESS EFFLUENT STREAM
CONVENTIONAL AND PRIORITY POLLUTANTS FOUND AT
ESSO PETROLEUM CANADA (SARNIA)

PARAMETER	N.	F.O.	MIN	MAX	AVG	UNIT
Arsenic	6	100	6.000	13.000	9.333	ug/L
COD	6	100	28.000	41.000	33.500	mg/L
DOC	76	100	1.600	16.000	9.206	mg/L
Hydrogen ion (pH)	171	100	7.100	8.400	7.739	
Nitrate+Nitrite	6	100	6.310	8.350	7.010	mg/L
Specific conductance	6	100	669.000	845.000	785.500	uS/cm
TOC	76	100	2.300	24.800	11.826	mg/L
Total Kjeldahl nitrogen	6	100	.810	1.260	.990	mg/L
Total suspended solids	76	100	1.900	46.200	12.104	mg/L
Total phosphorus	74	99	.000	4.100	.866	mg/L
VSS	171	99	.000	24.000	10.305	mg/L
Ammonia plus Ammonium	76	95	.000	5.000	.451	mg/L
Sulphide	76	89	.000	.600	.045	mg/L
Aluminum	6	83	.000	110.000	65.000	ug/L
Cyanide Total	6	83	.000	.012	.008	mg/L
Selenium	6	83	.000	24.000	13.667	ug/L
Zinc	6	83	.000	30.000	16.667	ug/L
Phenolics (4AAP)	170	68	.000	19.000	2.734	ug/L
Benzene	73	59	.000	20.000	1.633	ug/L
Nickel	6	50	.000	30.000	8.333	ug/L
Toluene	73	47	.000	13.530	1.288	ug/L
m-Xylene and p-Xylene	73	47	.000	13.100	1.608	ug/L
o-Xylene	73	45	.000	9.200	1.055	ug/L
Cadmium	6	33	.000	3.000	.833	ug/L
Methylene chloride	6	33	.000	1.600	.400	ug/L
Vanadium	6	33	.000	70.000	18.333	ug/L
Antimony	6	17	.000	9.000	1.500	ug/L
Lead	6	17	.000	40.000	6.667	ug/L
Ethylbenzene	73	14	.000	2.300	.132	ug/L
Oil and grease	76	12	.000	2.200	.149	mg/L

N. = number of analyses
F.O. = frequency of detection above the laboratory method detection limit (%)
MIN = minimum concentration
MAX = maximum concentration
AVG = average concentration in the period June 1 - November 30, 1989
UNIT = unit of measurement
▒▒ = conventional pollutant

TABLE 2.2
PROCESS EFFLUENT STREAM
CONVENTIONAL AND PRIORITY POLLUTANTS FOUND AT
PETRO-CANADA INC., LAKE ONTARIO REFINERY - MISSISSAUGA PLANT

PARAMETER	N.	F.O.	MIN	MAX	AVG	UNIT
Aluminum	5	100	150.000	620.000	328.000	ug/L
Antimony	5	100	.900	3.100	2.220	ug/L
Arsenic	5	100	2.000	12.000	5.740	ug/L
COD	6	100	42.000	84.000	57.833	mg/L
Chromium	80	100	20.000	350.000	139.200	ug/L
DOC	77	100	5.000	44.200	14.052	mg/L
Hydrogen ion (pH)	183	100	6.600	9.200	7.463	
Molybdenum	5	100	10.000	16.000	12.000	ug/L
Nickel	5	100	8.000	11.000	9.120	ug/L
Nitrate+Nitrite	6	100	.039	3.410	.691	mg/L
Oil and grease	78	100	1.500	18.700	5.217	mg/L
Specific conductance	6	100	515.000	718.000	604.833	uS/cm
Sulphide	90	100	.020	.870	.140	mg/L
TOC	77	100	3.700	45.200	22.083	mg/L
Total Kjeldahl nitrogen	6	100	1.020	5.180	2.387	mg/L
Total suspended solids	156	100	4.700	125.200	27.253	mg/L
Vanadium	5	100	26.000	140.000	89.200	ug/L
Zinc	80	100	20.000	670.000	100.388	ug/L
VSS	183	99	.000	76.000	15.338	mg/L
Phenolics (4AAP)	183	98	.000	71.000	10.768	ug/L
Ammonia plus Ammonium	78	95	.000	70.000	5.875	mg/L
Total phosphorus	77	88	.000	2.000	.291	mg/L
Cyanide Total	6	83	.000	.012	.005	mg/L
Chloroform	6	67	.000	14.600	4.205	ug/L
Selenium	5	60	.000	1.900	1.080	ug/L
Copper	5	20	.000	8.300	1.660	ug/L
Mercury	5	20	.000	.150	.030	ug/L
Phenanthrene	5	20	.000	.640	.128	ug/L
Pyrene	5	20	.000	.630	.126	ug/L
o-Xylene	78	14	.000	20.500	.958	ug/L
Toluene	78	9	.000	1.060	.047	ug/L
m-Xylene and p-Xylene	78	6	.000	22.000	.834	ug/L
Benzene	78	4	.000	1.690	.039	ug/L

N. = number of analyses
F.O. = frequency of detection above the laboratory method detection limit (%)
MIN = minimum concentration
MAX = maximum concentration
AVG = average concentration in the period June 1 - November 30, 1989
UNIT = unit of measurement
▒▒ = conventional pollutant

TABLE 2.3
PROCESS EFFLUENT STREAM
CONVENTIONAL AND PRIORITY POLLUTANTS FOUND AT
PETRO-CANADA INC., LAKE ONTARIO REFINERY - OAKVILLE PLANT

PARAMETER	N.	F.O.	MIN	MAX	AVG	UNIT
Aluminum	12	100	108.000	434.000	229.000	ug/L
Ammonia plus Ammonium	78	100	1.600	10.400	3.888	mg/L
Arsenic	12	100	7.000	34.000	20.000	ug/L
Bis(2-ethylhexyl) phthalate	1	100	3.070	3.070	3.070	ug/L
COD	7	100	63.000	119.000	89.857	mg/L
Chromium	83	100	17.000	390.000	88.241	ug/L
DOC	78	100	8.800	26.500	14.151	mg/L
Hexachlorobenzene	1	100	.100	.100	.100	ug/L
Hydrogen ion (pH)	182	100	7.500	8.800	8.005	
Molybdenum	12	100	9.000	20.000	15.167	ug/L
Nickel	12	100	3.000	16.000	6.033	ug/L
Nitrate+Nitrite	7	100	.133	.471	.273	mg/L
Octachlorodibenzo-p-dioxin	1	100	.071	.071	.071	ng/L
Octachlorostyrene	1	100	.140	.140	.140	ug/L
Oil and grease	79	100	.600	18.200	2.846	mg/L
Phenolics (4AAP)	183	100	8.000	140.000	30.623	ug/L
Specific conductance	7	100	1,790.000	2,280.000	2,071.429	uS/cm
Sulphide	78	100	.040	.400	.162	mg/L
TOC	78	100	14.300	47.200	25.459	mg/L
Total Kjeldahl nitrogen	7	100	1.510	9.600	5.720	mg/L
Total PCDF	1	100	.024	.024	.024	ng/L
Total TCDF	1	100	.065	.065	.065	ng/L
Total suspended solids	78	100	8.000	191.000	26.910	mg/L
VSS	182	100	4.000	47.000	17.236	mg/L
Zinc	83	100	17.000	15,390.000	237.819	ug/L
Total phosphorus	78	99	.000	2.600	.831	mg/L
Antimony	12	83	.000	1.200	.783	ug/L
Selenium	12	83	.000	13.600	7.367	ug/L
Cyanide Total	7	71	.000	.008	.005	mg/L
Bromomethane	7	43	.000	19.800	7.843	ug/L
Lead	12	33	.000	12.000	4.000	ug/L
1,1-Dichloroethylene	7	29	.000	2.170	.581	ug/L
Chloromethane	7	29	.000	10.000	2.386	ug/L
Methylene chloride	7	29	.000	.850	.233	ug/L
2,4-Dimethylphenol	8	25	.000	8.140	1.858	ug/L
Chrysene	8	25	.000	.330	.083	ug/L
Pyrene	8	25	.000	.520	.130	ug/L
Cadmium	12	17	.000	1.000	.167	ug/L
Copper	12	17	.000	8.000	1.333	ug/L
1,1,2-Trichloroethane	7	14	.000	.860	.123	ug/L
Toluene	78	10	.000	23.400	.361	ug/L
o-Xylene	78	9	.000	20.500	.491	ug/L
Benzene	78	6	.000	55.400	.740	ug/L
m-Xylene and p-Xylene	78	5	.000	18.500	.252	ug/L
Ethylbenzene	78	1	.000	3.180	.041	ug/L

N. = number of analyses
F.O. = frequency of detection above the laboratory method detection limit (%)
MIN = minimum concentration
MAX = maximum concentration
AVG = average concentration in the period June 1 - November 30, 1989
UNIT = unit of measurement
▒ = conventional pollutant

TABLE 2.4
PROCESS EFFLUENT STREAM
CONVENTIONAL AND PRIORITY POLLUTANTS FOUND AT
NOVA PETROCHEMICALS INC. (CORUNNA)

PARAMETER	N.	F.O.	MIN	MAX	AVG	UNIT
Aluminum	6	100	180.000	500.000	325.000	ug/L
COD	6	100	30.000	86.000	49.333	mg/L
Cyanide Total	6	100	.003	.006	.005	mg/L
DOC	74	100	3.000	37.000	14.297	mg/L
Hydrogen ion (pH)	176	100	6.570	8.800	7.848	
Nitrate+Nitrite	6	100	1.000	2.600	2.050	mg/L
Specific conductance	7	100	2,352.000	2,870.000	2,641.143	uS/cm
Sulphide	75	100	.050	.650	.154	mg/L
TOC	71	100	6.000	42.000	18.704	mg/L
Total Kjeldahl nitrogen	6	100	1.700	2.400	2.050	mg/L
Total phosphorus	76	100	.090	1.260	.398	mg/L
Total suspended solids	76	100	6.000	41.000	16.474	mg/L
Zinc	65	100	10.000	600.000	243.385	ug/L
Ammonia plus Ammonium	75	97	.000	9.800	1.016	mg/L
VSS	175	95	.000	24.000	9.474	mg/L
Phenolics (4AAP)	174	87	.000	19.000	4.483	ug/L
Chromium	60	85	.000	320.000	141.717	ug/L
Chloroform	6	83	.000	.980	.575	ug/L
Vanadium	6	50	.000	3.000	1.433	ug/L
Oil and grease	76	37	.000	5.400	.674	mg/L
Benzylbutylphthalate	6	33	.000	12.000	2.283	ug/L
Bis(2-ethylhexyl) phthalate	6	33	.000	1.600	.500	ug/L
Di-n-butyl phthalate	6	33	.000	1.200	.383	ug/L
4-Nitrophenol	6	17	.000	1.600	.267	ug/L
Copper	6	17	.000	3.000	.500	ug/L
Indeno(1,2,3-cd)pyrene	6	17	.000	.860	.143	ug/L
Mercury	6	17	.000	.130	.022	ug/L
Benzene	76	3	.000	.800	.020	ug/L

N. = number of analyses
F.O. = frequency of detection above the laboratory method detection limit (%)
MIN = minimum concentration
MAX = maximum concentration
AVG = average concentration in the period June 1 - November 30, 1989
UNIT = unit of measurement
▒▒ = conventional pollutant

TABLE 2.5
PROCESS EFFLUENT STREAM
CONVENTIONAL AND PRIORITY POLLUTANTS FOUND AT
SHELL CANADA PRODUCTS LIMITED (SARNIA)

PARAMETER	N.	F.O.	MIN	MAX	AVG	UNIT
Aluminum	6	100	220.000	2,700.000	943.333	ug/L
COD	6	100	13.000	78.000	41.333	mg/L
Cyanide Total	6	100	.004	.009	.006	mg/L
DOC	80	100	3.000	256.000	22.697	mg/L
Hydrogen ion (pH)	183	100	6.400	8.800	7.763	
Nitrate+Nitrite	3	100	.200	.350	.293	mg/L
Specific conductance	6	100	580.000	1,100.000	759.500	uS/cm
TOC	80	100	7.000	308.000	33.596	mg/L
Total Kjeldahl nitrogen	6	100	.260	2.100	1.140	mg/L
Phenolics (4AAP)	183	98	.000	70.000	6.394	ug/L
Total suspended solids	183	98	.000	792.000	48.306	mg/L
VSS	183	91	.000	504.000	29.219	mg/L
Oil and grease	131	87	.000	8.100	2.548	mg/L
Zinc	80	85	.000	800.000	33.130	ug/L
Copper	6	83	.000	11.000	4.833	ug/L
Total phosphorus	80	78	.000	2.100	.444	mg/L
Arsenic	6	50	.000	5.000	2.000	ug/L
Cobalt	6	50	.000	6.000	2.167	ug/L
Vanadium	6	50	.000	28.000	7.500	ug/L
1,2-Dichloropropane	6	33	.000	27.000	5.150	ug/L
Sulphide	131	31	.000	.700	.063	mg/L
Chromium	80	29	.000	86.000	10.397	ug/L
Benzylbutylphthalate	6	17	.000	1.100	.183	ug/L
Bis(2-ethylhexyl) phthalate	6	17	.000	1.600	.267	ug/L
Phenol	6	17	.000	1.900	.317	ug/L
Ammonia plus Ammonium	131	16	.000	8.200	.191	mg/L
Toluene	80	15	.000	38.300	.865	ug/L
m-Xylene and p-Xylene	80	14	.000	43.410	1.000	ug/L
Benzene	80	3	.000	.830	.018	ug/L

N. = number of analyses
F.O. = frequency of detection above the laboratory method detection limit (%)
MIN = minimum concentration
MAX = maximum concentration
AVG = average concentration in the period June 1 - November 30, 1989
UNIT = unit of measurement
▒▒ = conventional pollutant

TABLE 2.6
PROCESS EFFLUENT STREAM
CONVENTIONAL AND PRIORITY POLLUTANTS FOUND AT
SUNCOR INC. (SARNIA)

PARAMETER	N.	F.O.	MIN	MAX	AVG	UNIT
Arsenic	6	100	3.000	8.000	5.167	ug/L
COD	6	100	8.000	25.000	19.333	mg/L
Hydrogen ion (pH)	183	100	6.500	8.400	7.517	
Nitrate+Nitrite	9	100	2.030	13.900	8.162	mg/L
Selenium	6	100	3.000	5.000	3.667	ug/L
Specific conductance	6	100	1,273.000	1,440.000	1,378.833	uS/cm
Total H7CDD	1	100	.040	.040	.040	ng/L
Total phosphorus	79	100	.040	1.500	.218	mg/L
Total suspended solids	149	100	2.000	130.000	7.792	mg/L
Zinc	6	100	20.000	90.000	41.667	ug/L
DOC	80	99	.000	91.000	9.903	mg/L
TOC	79	99	.000	85.000	10.174	mg/L
VSS	183	99	.000	20.000	5.038	mg/L
Ammonia plus Ammonium	85	98	.000	9.600	1.351	mg/L
Phenolics (4AAP)	183	96	.000	24.000	4.656	ug/L
Oil and grease	79	90	.000	8.900	1.085	mg/L
Total Kjeldahl nitrogen	9	89	.000	.600	.399	mg/L
Sulphide	78	74	.000	.070	.019	mg/L
Aluminum	6	50	.000	720.000	198.333	ug/L
1,2-Dichloroethane	6	33	.000	.300	.083	ug/L
Chloroform	6	33	.000	3.900	.850	ug/L
Copper	6	33	.000	140.000	25.000	ug/L
Cyanide Total	6	33	.000	.010	.003	mg/L
Toluene	83	20	.000	3.300	.245	ug/L
Nickel	6	17	.000	10.000	1.667	ug/L
m-Xylene and p-Xylene	83	4	.000	.700	.020	ug/L
o-Xylene	83	2	.000	5.100	.082	ug/L
Ethylbenzene	83	1	.000	.400	.005	ug/L

N. = number of analyses
F.O. = frequency of detection above the laboratory method detection limit (%)
MIN = minimum concentration
MAX = maximum concentration
AVG = average concentration in the period June 1 - November 30, 1989
UNIT = unit of measurement
= conventional pollutant

TABLE 2.7
PROCESS EFFLUENT STREAM
CONVENTIONAL AND PRIORITY POLLUTANTS FOUND AT
ESSO PETROLEUM CANADA (NANTICOKE)

PARAMETER	N.	F.O.	MIN	MAX	AVG	UNIT
Aluminum	6	100	100.000	160.000	136.667	ug/L
Arsenic	6	100	8.000	15.000	11.667	ug/L
COD	6	100	24.000	32.000	27.333	mg/L
Cadmium	6	100	.100	.600	.243	ug/L
Chloromethane	6	100	1.080	7.420	4.178	ug/L
DOC	82	100	3.900	35.000	7.746	mg/L
Hydrogen ion (pH)	187	100	6.500	8.600	7.724	
Molybdenum	6	100	40.000	40.000	40.000	ug/L
Nitrate+Nitrite	6	100	1.830	3.100	2.422	mg/L
Selenium	6	100	6.000	8.000	7.167	ug/L
Specific conductance	6	100	1,650.000	2,300.000	1,915.000	uS/cm
TOC	14	100	5.300	11.300	7.193	mg/L
Thallium	6	100	15.000	20.000	18.667	ug/L
Total Kjeldahl nitrogen	6	100	.940	1.250	1.090	mg/L
Total suspended solids	82	100	2.000	13.200	6.722	mg/L
Zinc	6	100	14.000	40.000	26.500	ug/L
VSS	186	97	.000	13.200	4.246	mg/L
Ammonia plus Ammonium	82	93	.000	8.790	.483	mg/L
Total phosphorus	86	87	.000	1.000	.311	mg/L
Phenolics (4AAP)	187	85	.000	18.000	3.727	ug/L
Cyanide Total	6	83	.000	.023	.016	mg/L
Sulphide	85	72	.000	.440	.035	mg/L
Methylene chloride	6	67	.000	33.000	7.833	ug/L
Oil and grease	85	66	.000	6.500	1.319	mg/L
1,1-Dichloroethane	6	50	.000	.370	.168	ug/L
1,1-Dichloroethylene	6	50	.000	1.560	.613	ug/L
Benz(a)anthracene	6	50	.000	3.000	1.500	ug/L
Benzo(a)pyrene	6	50	.000	6.000	3.000	ug/L
Benzo(b)fluoranthene	6	50	.000	4.000	2.000	ug/L
Benzo(g,h,i)perylene	6	50	.000	10.000	5.000	ug/L
Benzo(k)fluoranthene	6	50	.000	6.000	3.000	ug/L
Chloroform	6	50	.000	2.900	1.192	ug/L
Chromium (hexavalent)	6	50	.000	14.000	5.167	ug/L
Copper	6	50	.000	10.000	3.333	ug/L
Dibenz(a,h)anthracene	6	50	.000	10.000	5.000	ug/L
Indeno(1,2,3-cd)pyrene	6	50	.000	10.000	5.000	ug/L
Perylene	6	50	.000	6.000	3.000	ug/L
Vanadium	6	50	.000	9.000	3.667	ug/L
Bromomethane	6	33	.000	.950	.315	ug/L
Chromium	6	33	.000	10.000	3.167	ug/L
Chrysene	6	33	.000	3.000	1.000	ug/L
Mercury	6	33	.000	.100	.025	ug/L
Nickel	6	33	.000	8.000	2.333	ug/L
Lead	6	17	.000	1.200	.200	ug/L
o-Xylene	80	14	.000	1.520	.049	ug/L
Benzene	80	11	.000	2.100	.084	ug/L
Toluene	80	11	.000	1.290	.047	ug/L
m-Xylene and p-Xylene	80	5	.000	1.680	.051	ug/L
Ethylbenzene	80	3	.000	.020	.000	ug/L

N. = number of analyses
F.O. = frequency of detection above the laboratory method detection limit (%)
MIN = minimum concentration
MAX = maximum concentration
AVG = average concentration in the period June 1 - November 30, 1989
UNIT = unit of measurement
▒▒ = conventional pollutant

TABLE 3.0
PROCESS EFFLUENT STREAMS
MONTHLY AVERAGE DAILY FLOW (m^3/day) FOR SEVEN REFINERIES

REFINERY	JUN 89	JUL 89	AUG 89	SEP 89	OCT 89	NOV 89
1	31,370	30,761	29,695	33,079	28,556	27,296
2	13,388	11,559	12,935	12,019	11,655	13,647
3	5,768	5,507	5,328	5,021	4,859	4,858
4	6,219	6,674	6,073	5,376	5,445	5,825
5	13,703	15,768	15,828	16,393	13,690	12,634
6	9,364	8,461	9,602	9,483	9,362	8,021
7	6,734	6,347	6,017	6,404	6,345	6,757

Note: For a key to the refinery numbers refer to Appendix B.

TABLE 4.0
PROCESS EFFLUENT STREAMS
AVERAGE DAILY LOADING (kg/day)
FOR DAILY AND THRICE WEEKLY PARAMETERS FOR SEVEN REFINERIES
(JUNE 1 - NOVEMBER 30, 1989)

PARAMETER	REFINERY						
	1	2	3	4	5	6	7
Ammonia plus Ammonium	13.56	67.20	19.08	5.86	2.42	12.10	3.02
Benzene	.05	.00	.00	.00	.00	.00	.00
Chromium	.00	1.61	.41	.91	.15	.00	.02
DOC	276.37	168.71	70.28	89.74	327.34	86.63	49.04
Ethylbenzene	.00	.00	.00	.00	.00	.00	.00
Oil and grease	4.34	61.73	14.34	3.72	36.86	9.55	8.62
Phenolics (4AAP)	.08	.14	.16	.03	.09	.04	.02
Sulphide	1.36	2.19	.82	.95	.82	.17	.21
TOC	356.20	263.84	127.63	119.18	476.53	92.06	47.62
Toluene	.04	.00	.00	.00	.01	.00	.00
Total phosphorus	25.60	3.27	4.12	2.30	6.45	1.84	1.85
Total suspended solids	367.49	372.68	142.03	103.16	672.46	71.34	43.10
VSS	310.83	203.33	92.49	57.19	412.05	46.06	27.38
Zinc	.41	1.18	1.35	1.52	.45	.14	.16
m-Xylene and p-Xylene	.05	.01	.00	.00	.01	.00	.00
o-Xylene	.03	.01	.00	.00	.00	.00	.00

Note: For a key to the refinery numbers refer to Appendix B.

= conventional pollutant

Figure 1.1
Process Effluent Stream
Monthly Average Concentration of Benzene

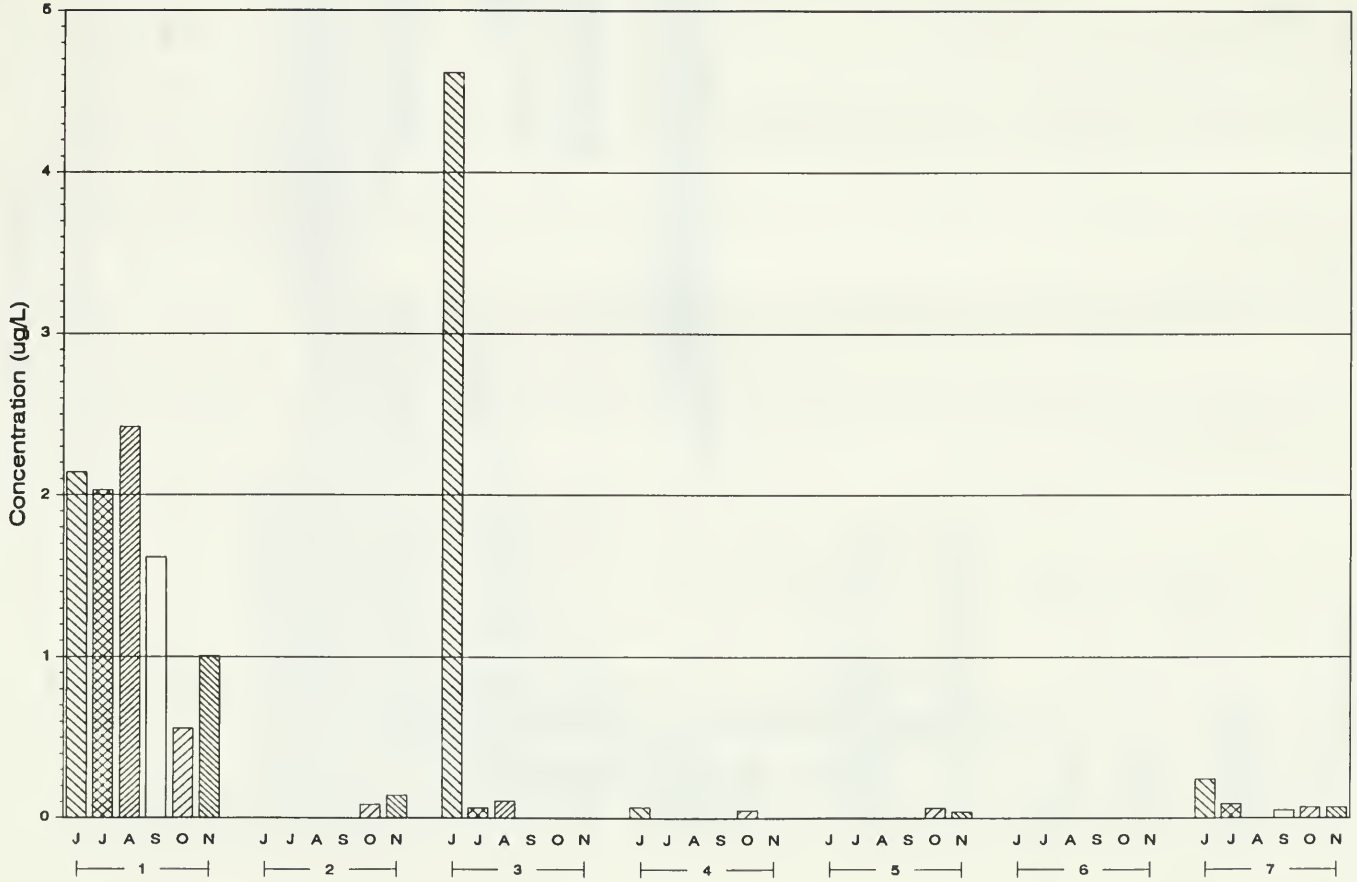


Figure 1.2
Process Effluent Stream
Monthly Average Concentration of Chromium

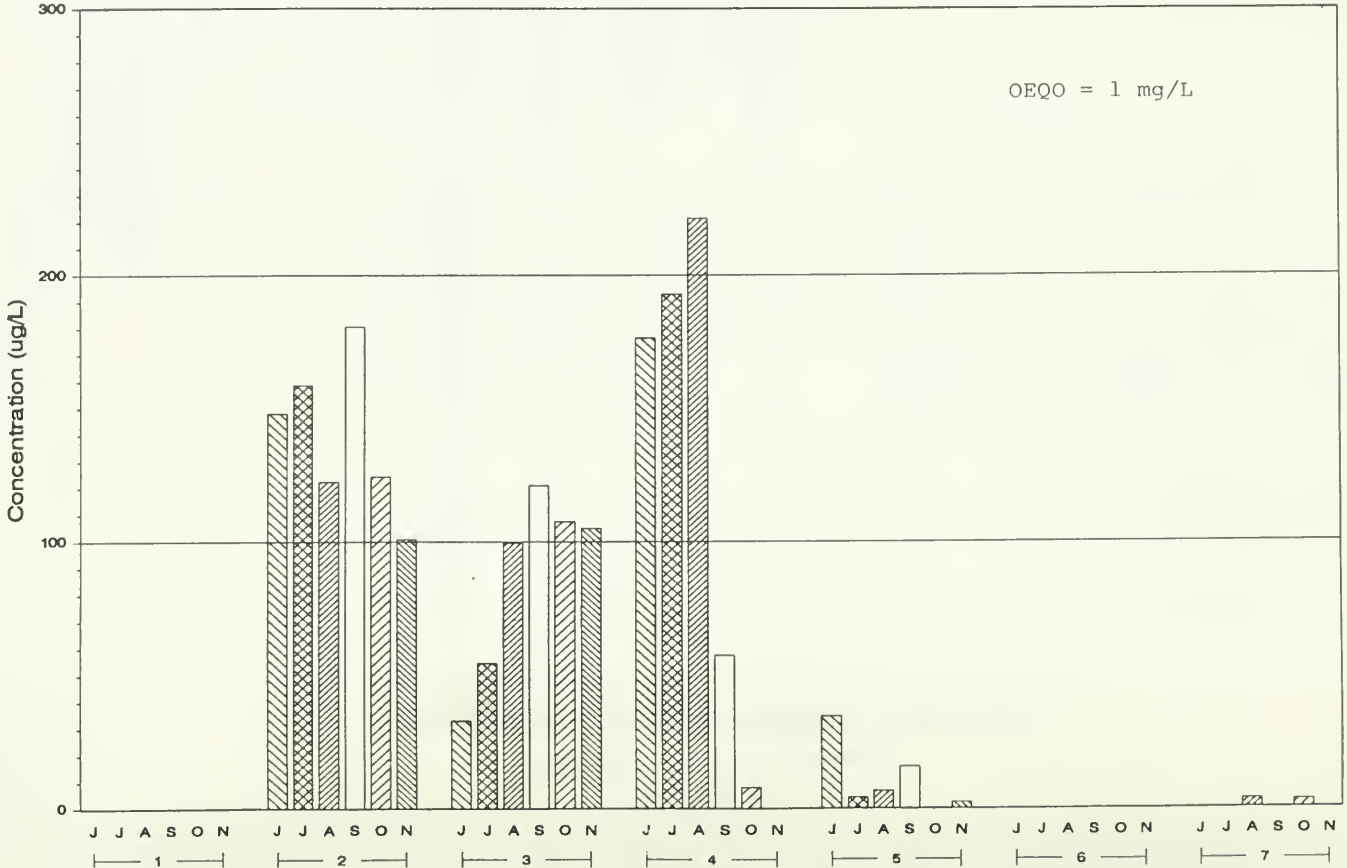


Figure 1.3
Process Effluent Stream
Monthly Average Concentration of Oil & Grease

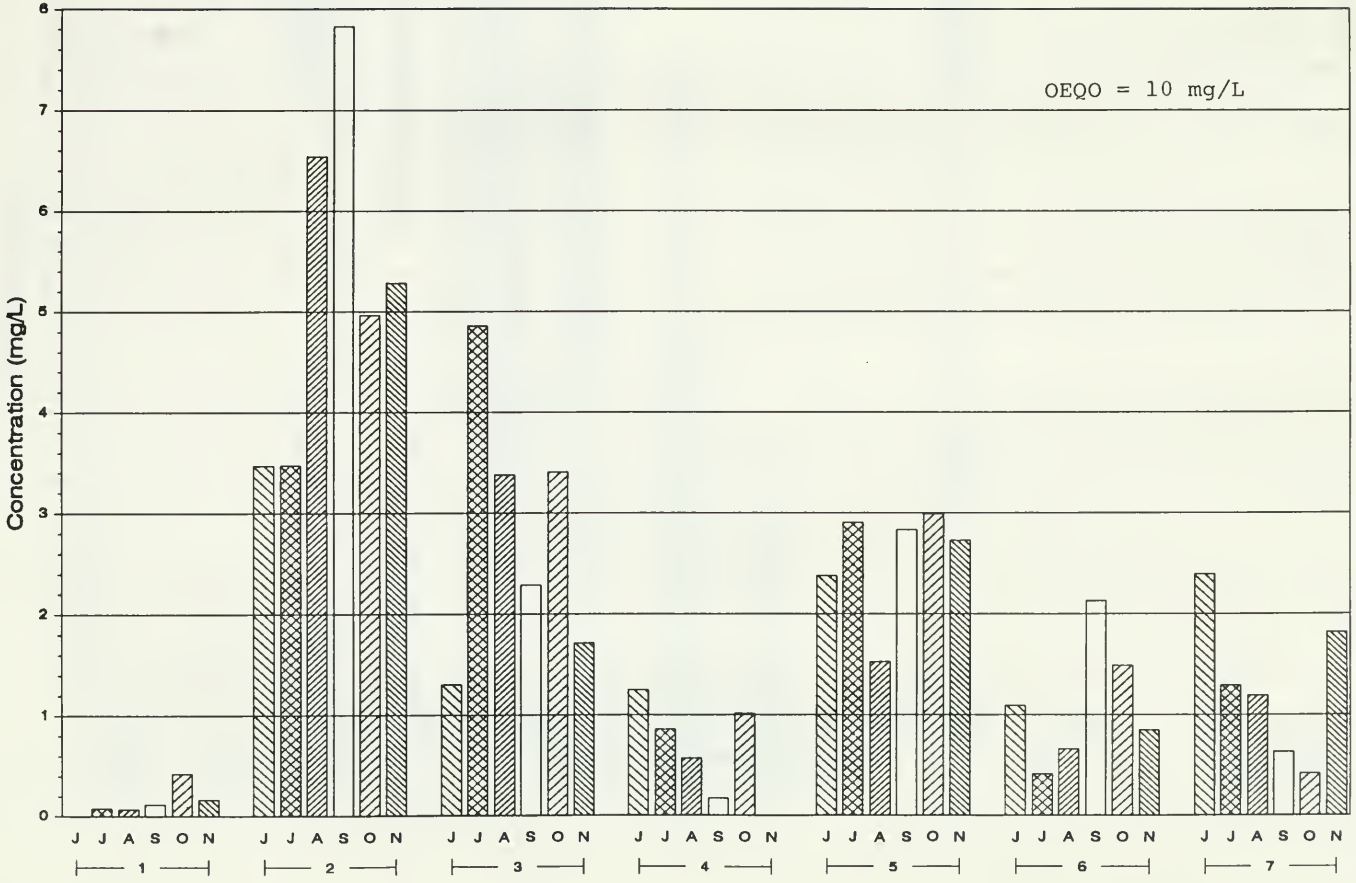


Figure 1.4
Process Effluent Stream
Monthly Average Concentration of Phenolics – 4AAP

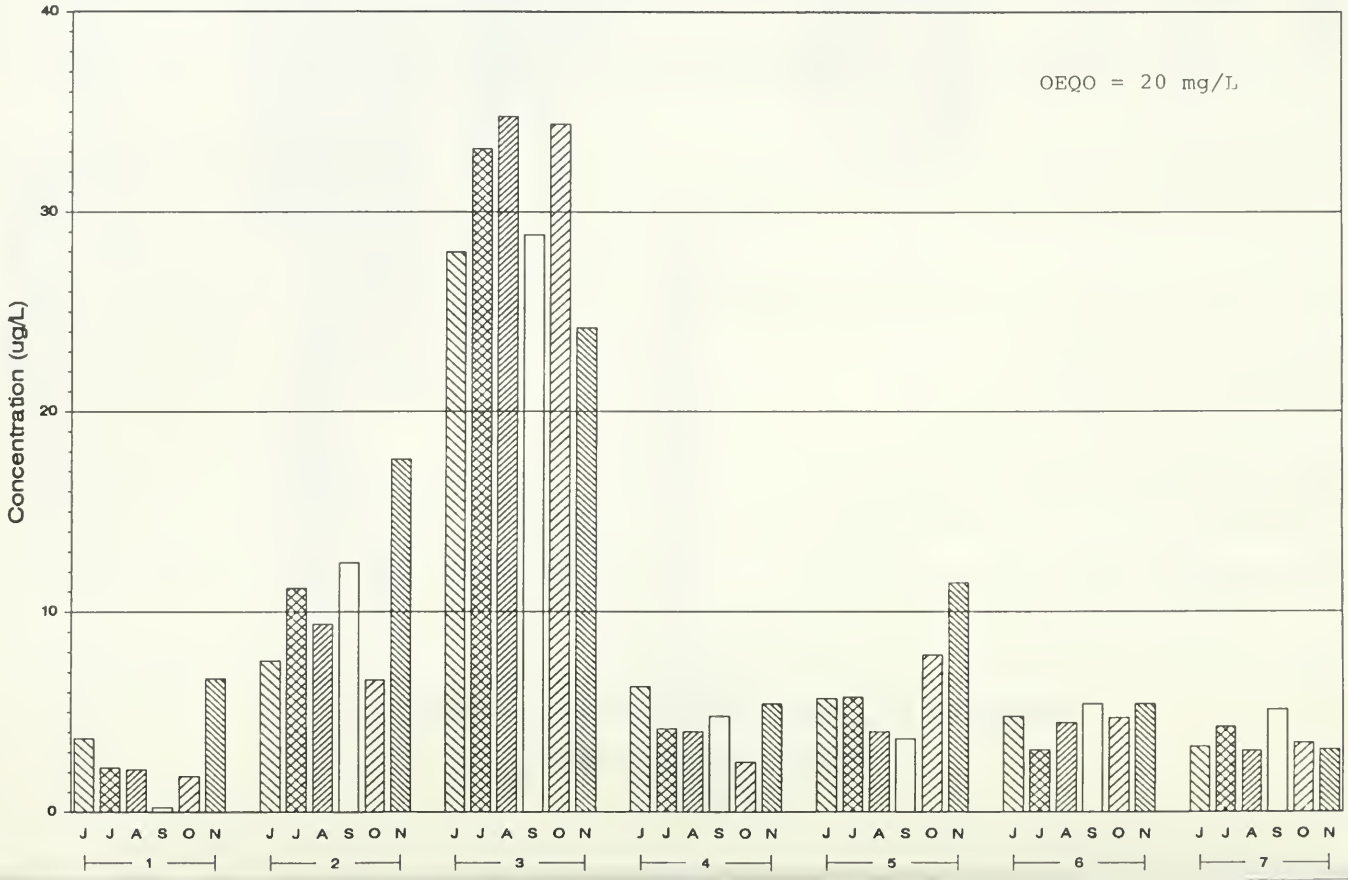


Figure 1.5
Process Effluent Stream
Monthly Average Concentration of Sulphide

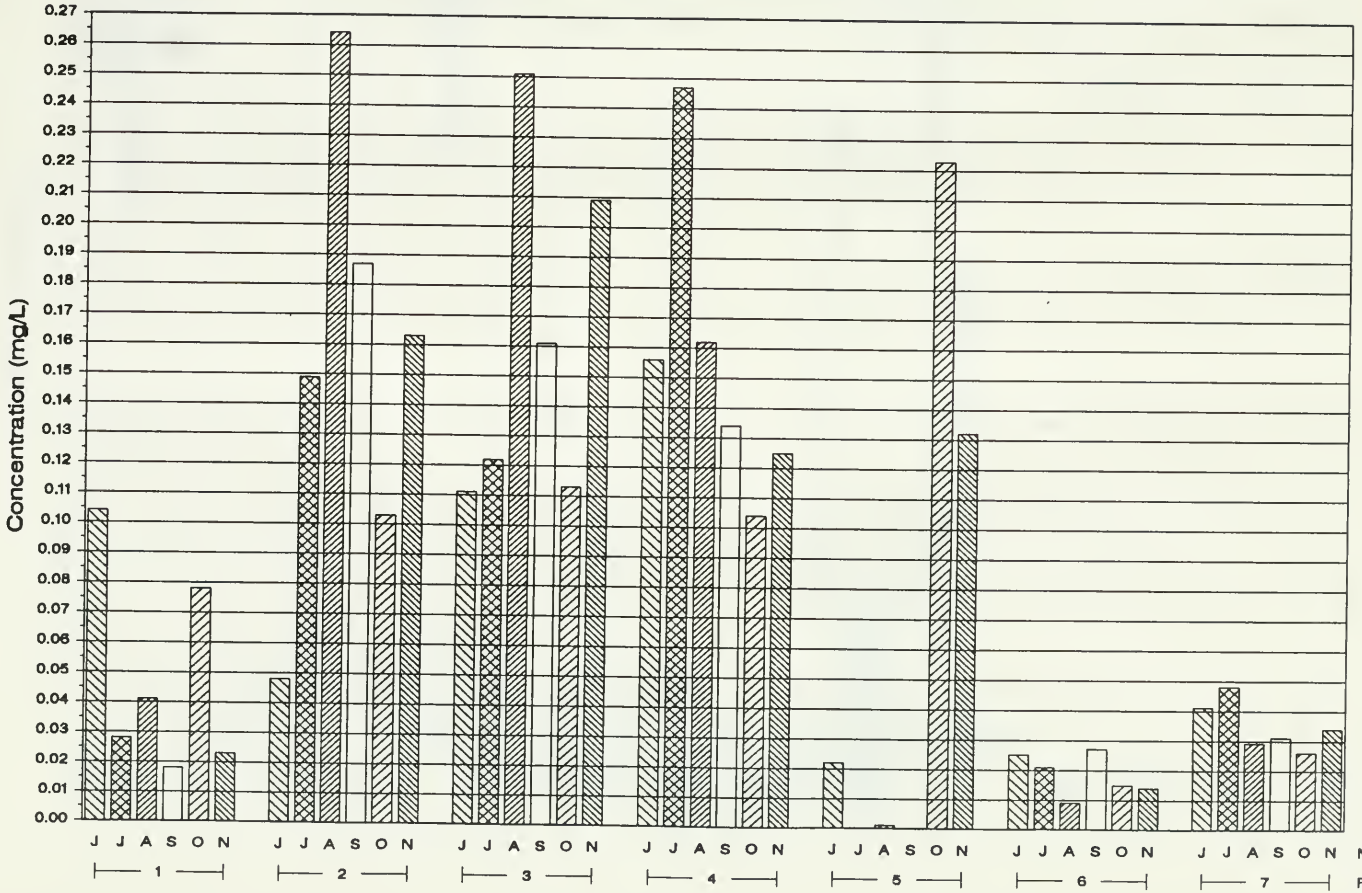


Figure 1.6
Process Effluent Stream
Monthly Average Concentration of Toluene

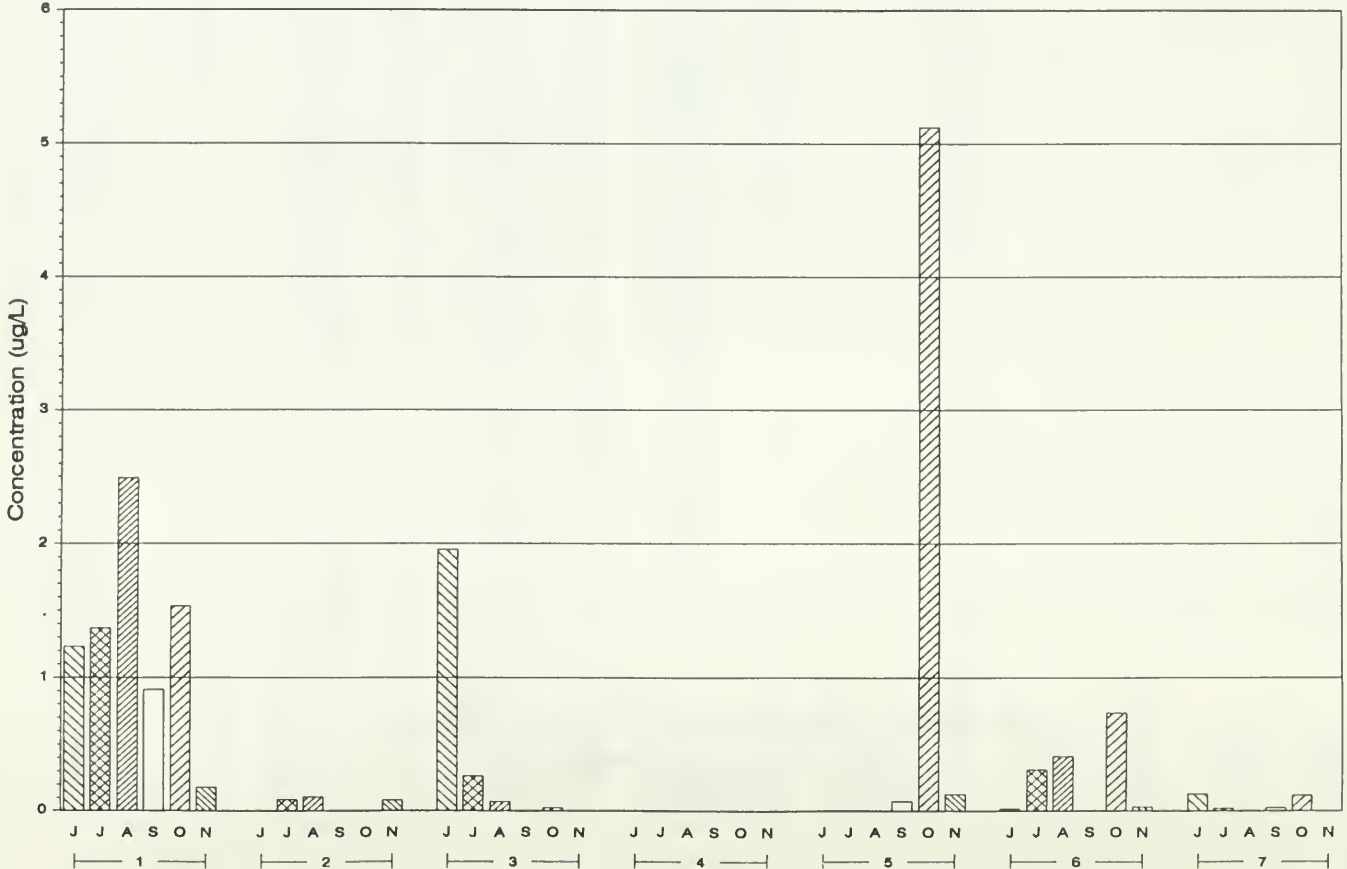


Figure 1.7
Process Effluent Stream
Monthly Average Concentration of TSS (Total Suspended Solids)

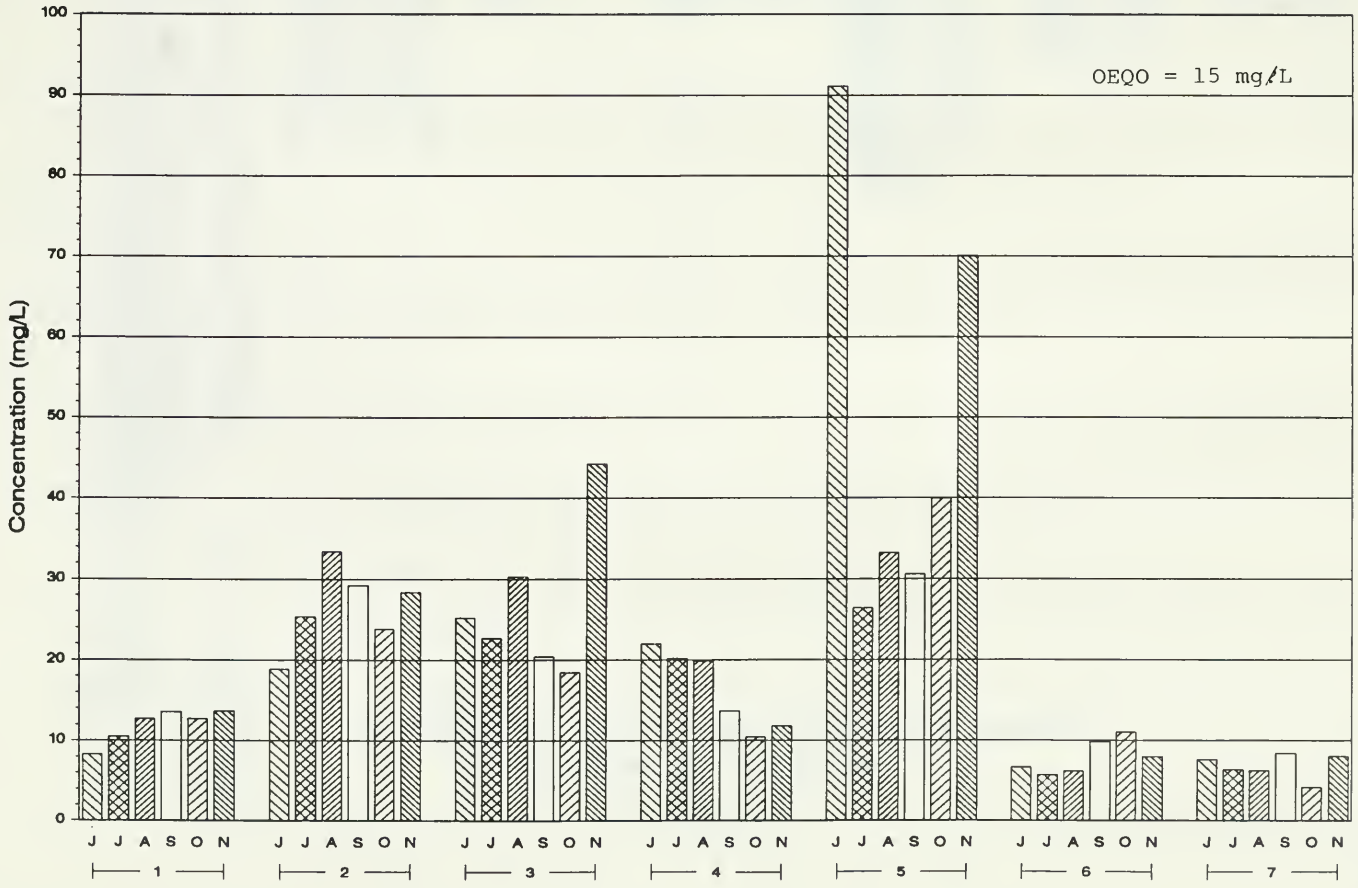


Figure 2.0
Process Effluent Stream
Monthly Average Daily Flow for Seven Refineries

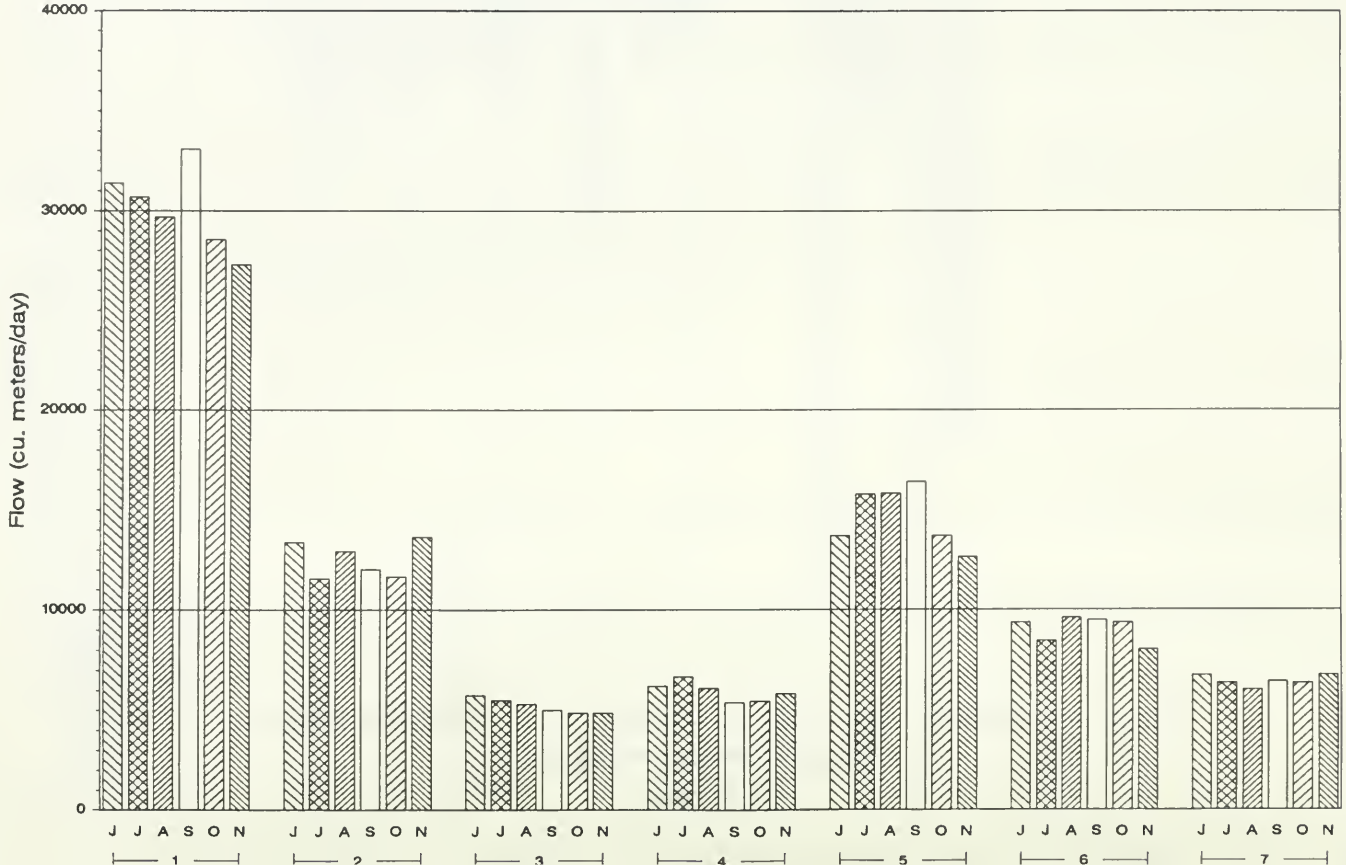


Figure 3.1
Process Effluent Stream
Monthly Average Daily Loading of Benzene

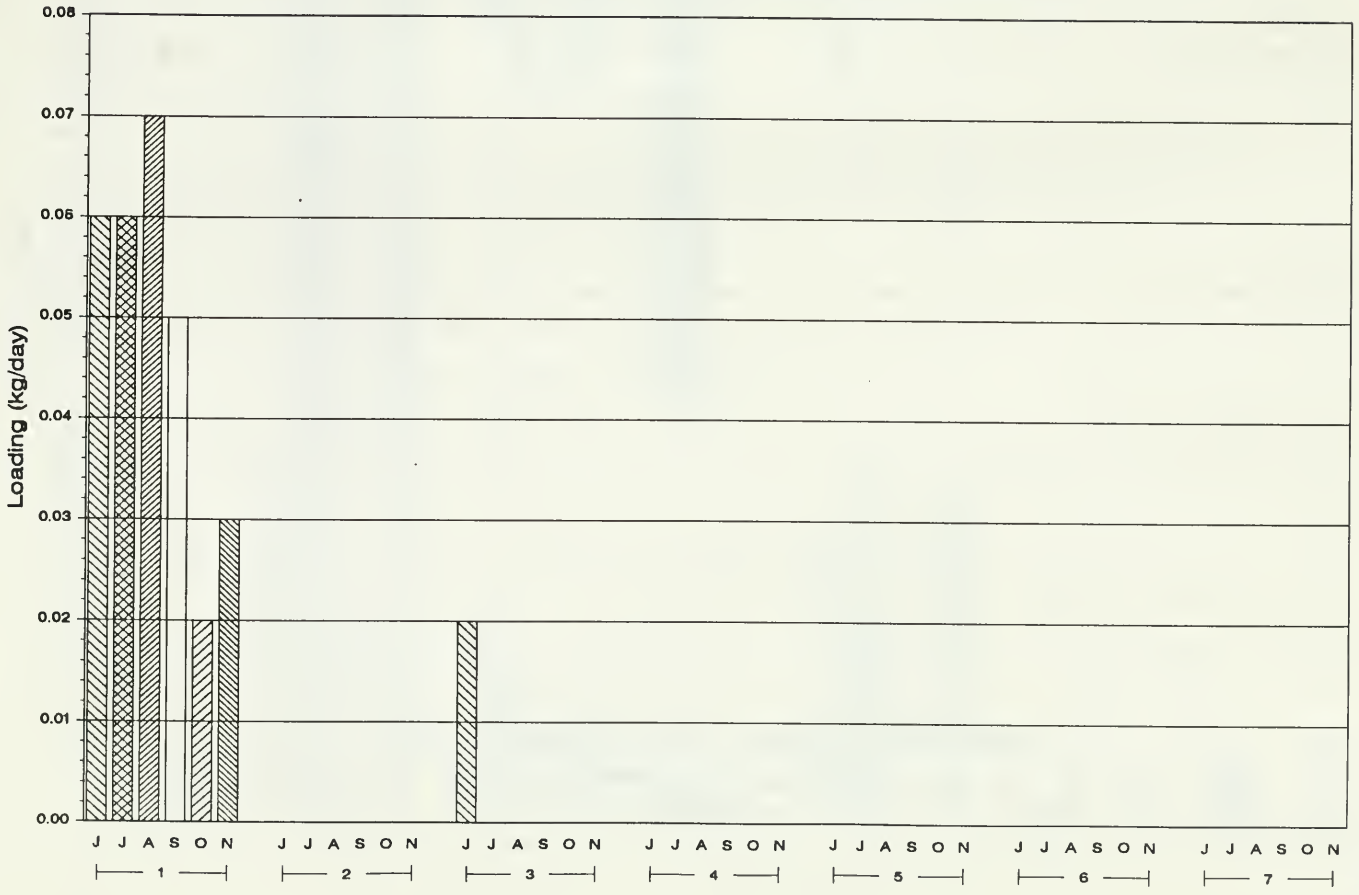


Figure 3.2
Process Effluent Stream
Monthly Average Daily Loading of Chromium

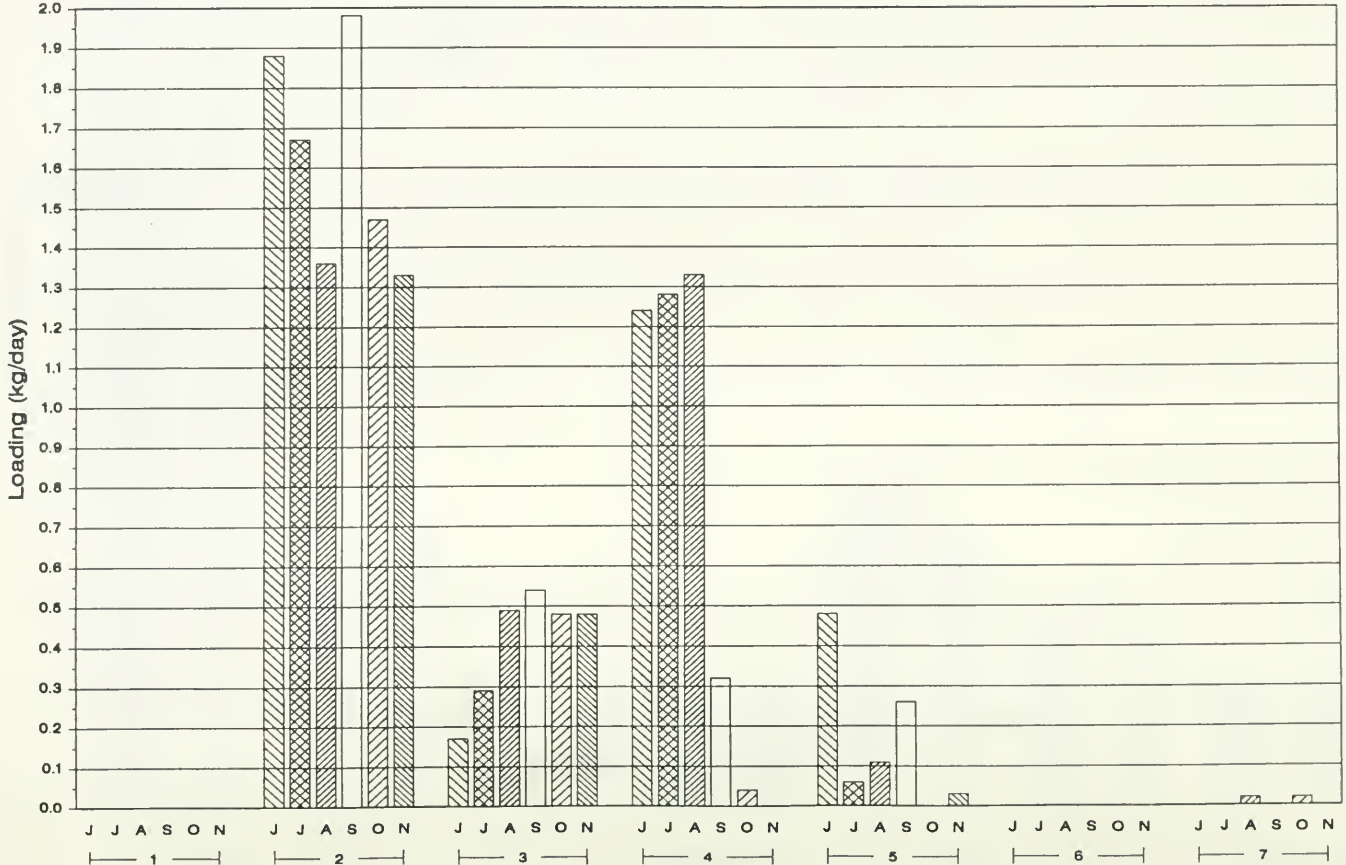


Figure 3.3
Process Effluent Stream
Monthly Average Daily Loading of Oil & Grease

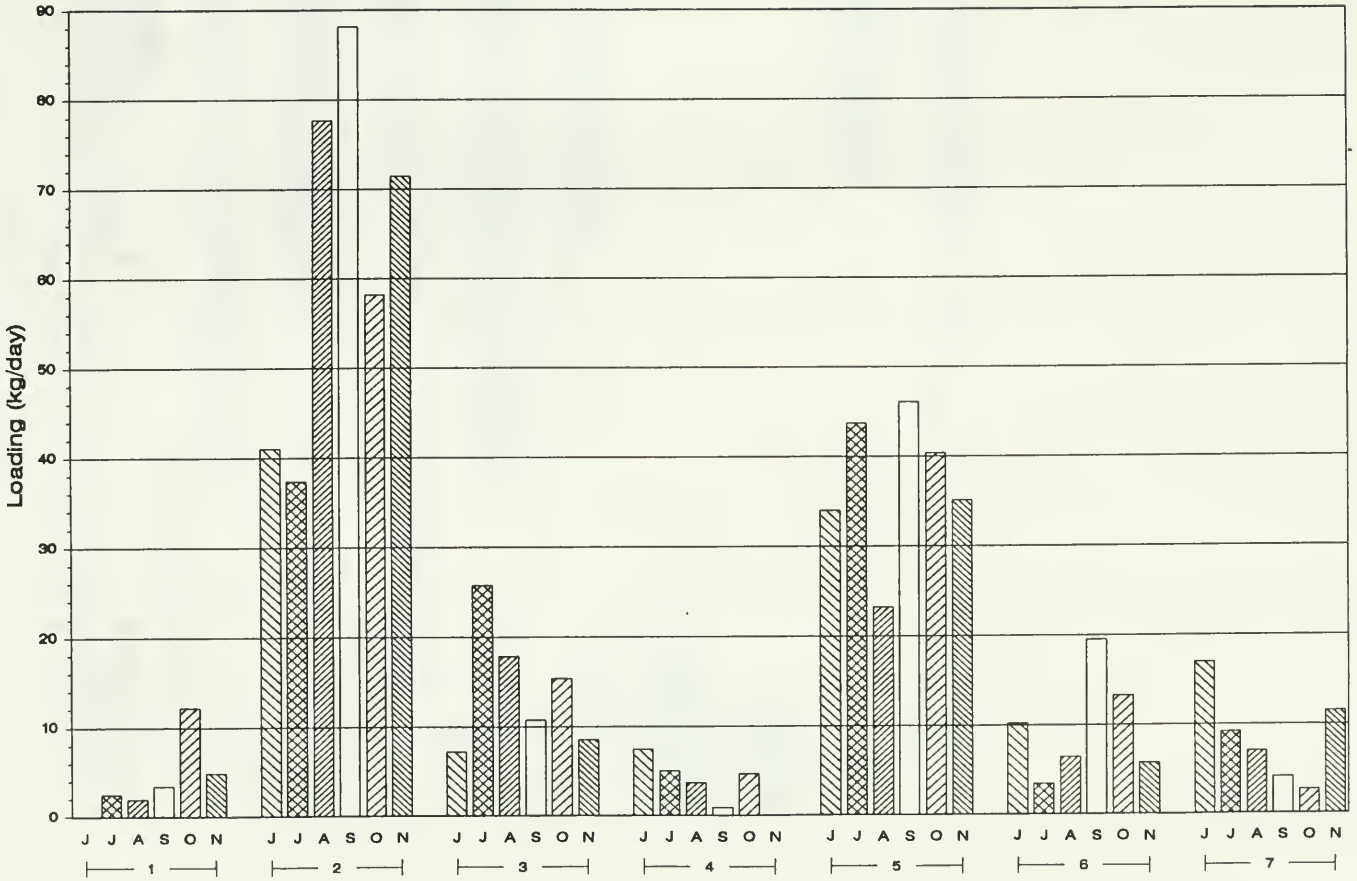


Figure 3.4
Process Effluent Stream
Monthly Average Daily Loading of Phenolics – 4AAP

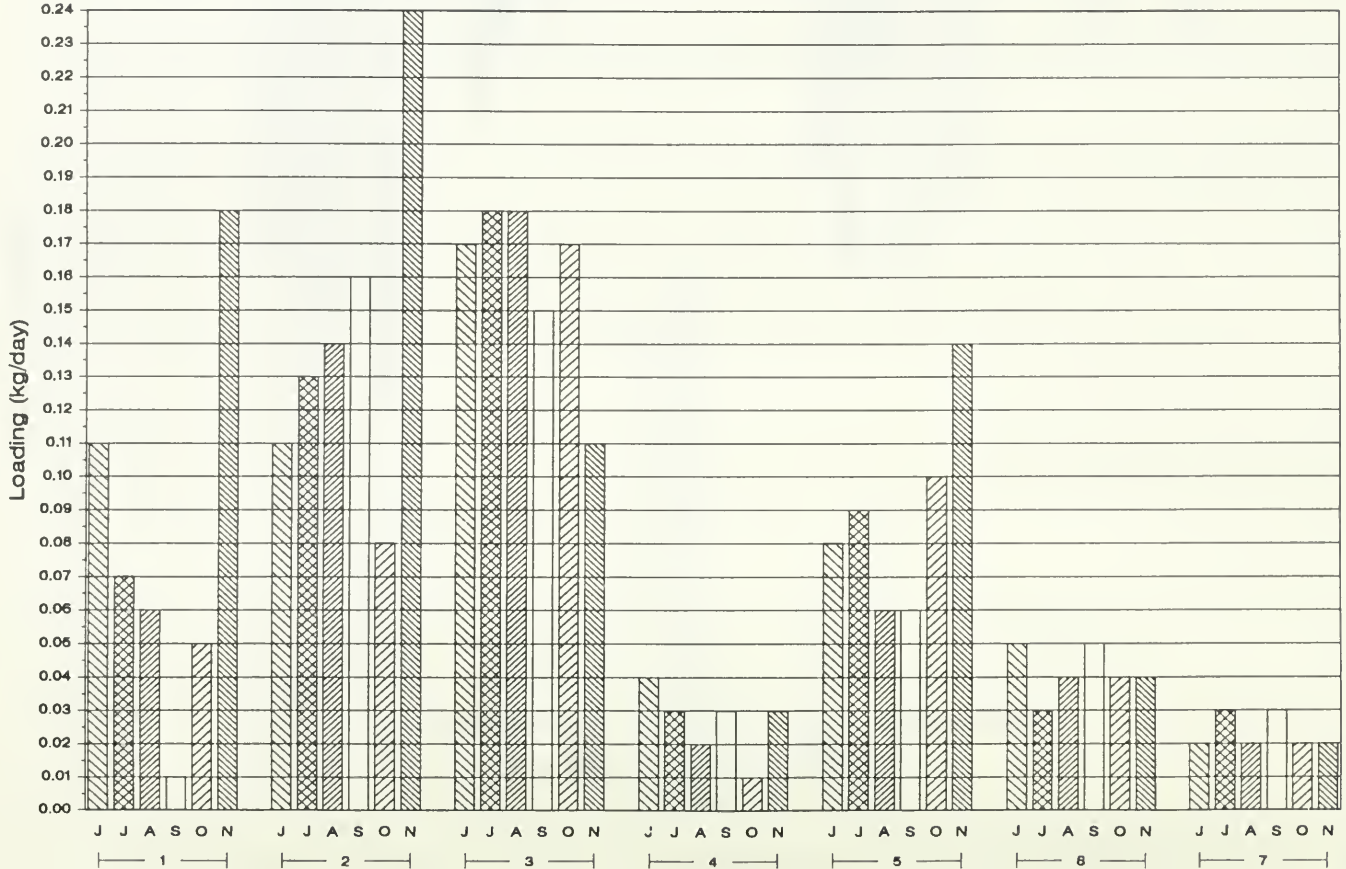


Figure 3.5
Process Effluent Stream
Monthly Average Daily Loading of Sulphide

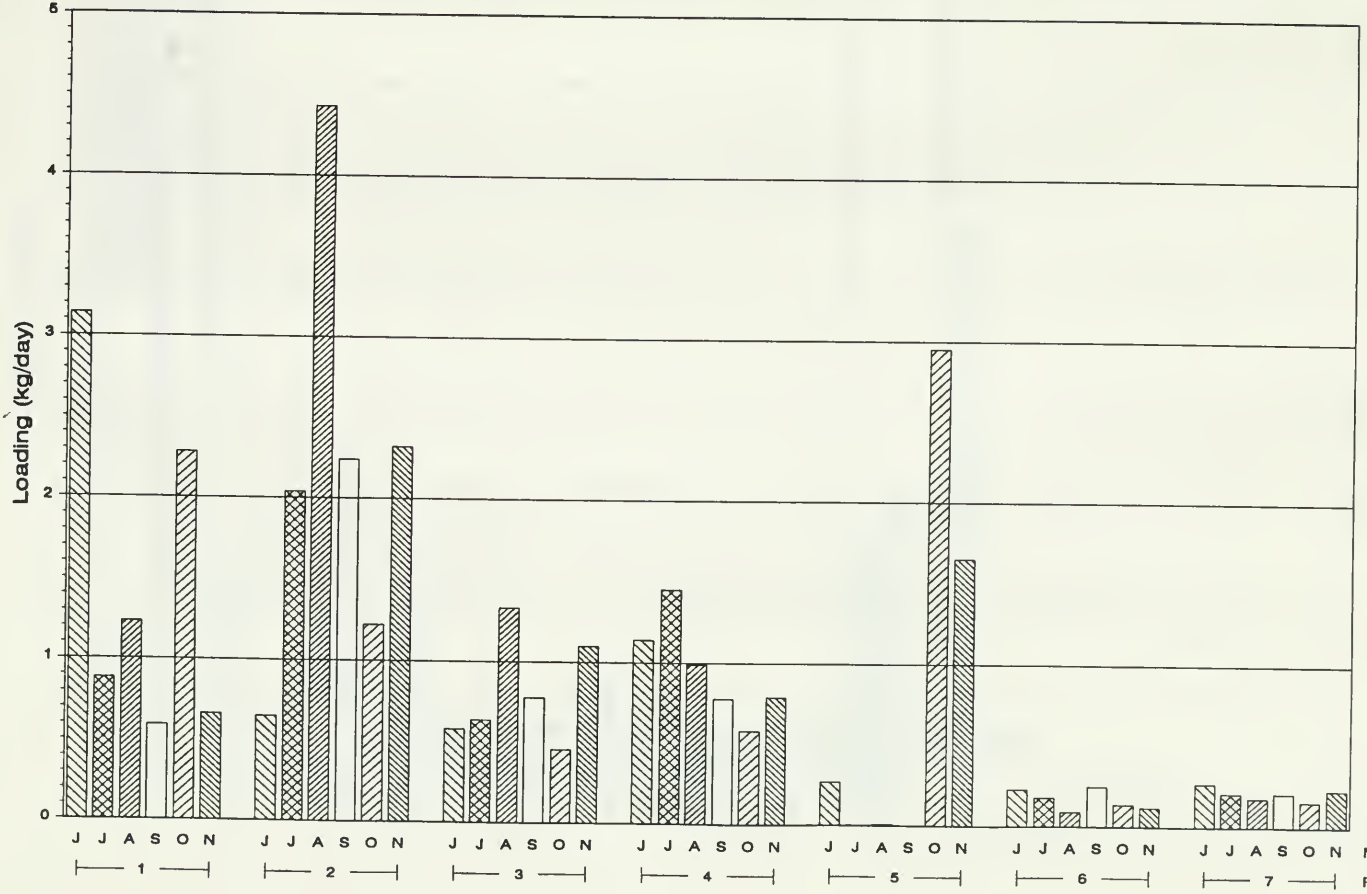


Figure 3.6
Process Effluent Stream
Monthly Average Daily Loading of Toluene

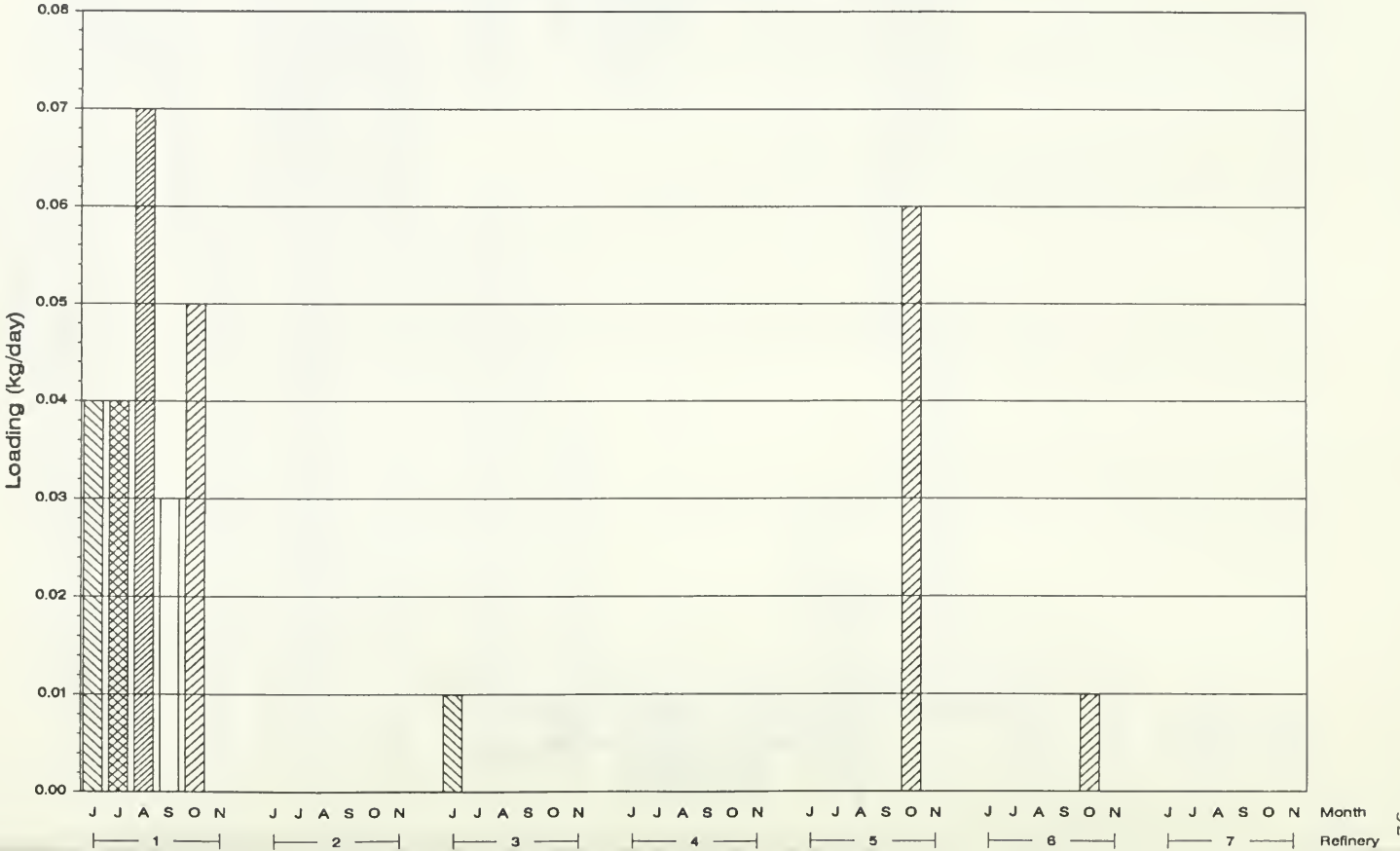
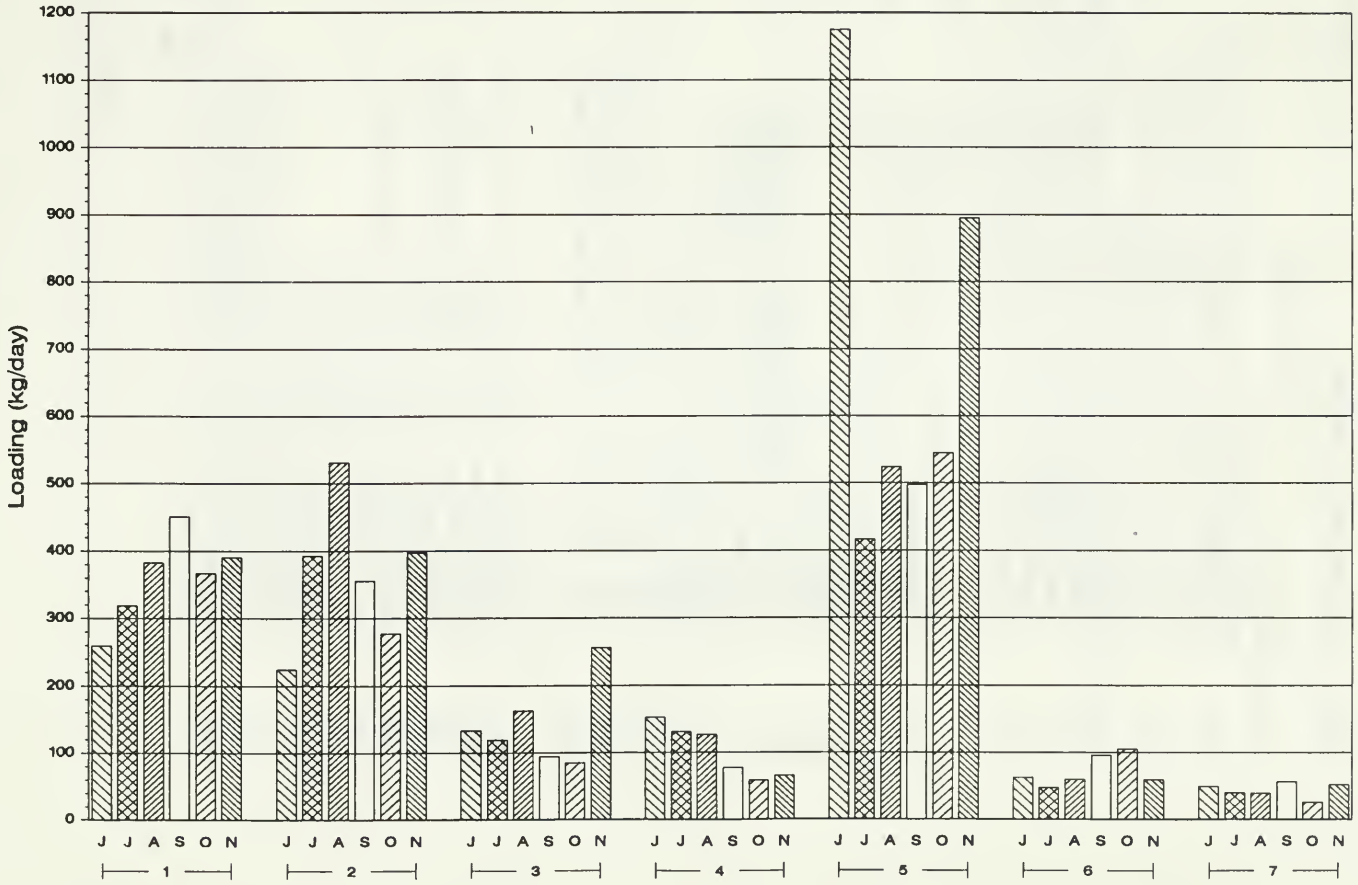


Figure 3.7
Process Effluent Stream
Monthly Average Daily Loading of TSS (Total Suspended Solids)



12.2 REMARK CODES

Code	Description
?	Late data : data yet available : see text
NA	No data will be reported: see textual report
!NM	No effluent - no sample available
<	Actual amount less than reported
<DL	Reported value = MDL :measured amt. < MDL (non-zero)
<T	A measurable trace amount: interpret with caution
<TE	A measurable trace after extra diln/concn: caution
<W	No measurable response (zero): < reported value
<WE	No measurable response (diln/concn): < rept'd value
>	Actual amount probably greater than reported
A	Approximate value
AIS	Approximate value: insufficient sample
AR	Attached report
I	Interference suspected
IB	Interference: background
IC	Interference: colour
IM	Interference: Sample Matrix
MP	Multiphase sample: Result may be suspect
O	Old: sample exceeds maximum storage time
SD	Sample duplicates differ in appearance
SID	Sample identification questionable
SIP	Sample improperly preserved
UCR	Data unreliable: could not confirm by reanalysis
UNF	Data unreliable: container not filled to top
UQC	Data unreliable: possible lab QC problem(s)
USD	Data unreliable: Sample decomposition noted
P16	PCB resembled AROCLOR 1016
P20	PCB resembled mix of AROCLOR 1242 and 1260
P21	PCB resembled AROCLOR 1221
P24	PCB resembled mix of AROCLOR 1242 and 1254
P28	PCB resembled mix of AROCLOR 1242 and 1248
P32	PCB resembled AROCLOR 1232
P40	PCB resembled mix of AROCLOR 1254 and 1260
P42	PCB resembled AROCLOR 1242
P48	PCB resembled AROCLOR 1248
P54	PCB resembled AROCLOR 1254
P60	PCB resembled AROCLOR 1260
P80	PCB resembled mix of AROCLOR 1248 and 1260
P84	PCB resembled mix of AROCLOR 1248 and 1254
PS1	PCB resembled mix of AROCLOR 1248, 1254 and 1260
PS2	PCB resembled mix of AROCLOR 1242, 1254 and 1260

APPENDIX B

Key to the Refinery Numbers Used in Tables and Figures

Refinery 1 = Esso Petroleum Canada (Sarnia)

Refinery 2 = Petro-Canada Inc., Lake Ontario Refinery - Mississauga Plant

Refinery 3 = Petro-Canada Inc., Lake Ontario Refinery - Oakville Plant

Refinery 4 = NOVA Petrochemicals Inc. (Corunna) (previously Petrosar Limited)

Refinery 5 = Shell Canada Products Limited (Sarnia)

Refinery 6 = Suncor Inc. (Sarnia)

Refinery 7 = Esso Petroleum Canada (Nanticoke) (previously Texaco Canada Inc.)

APPENDIX C

Results on Once-through Cooling Water Effluent Streams and Intake Water
(Monitoring Data from December 1, 1988 to November 30, 1989)

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NOTE 1: There are no designated once-through cooling water effluent streams at three refineries: Petro-Canada Inc., Lake Ontario Refinery - Oakville Plant; NOVA Petrochemicals Inc.; and Esso Petroleum Canada, Nanticoke Refinery.

NOTE 2: Esso Petroleum Canada, Sarnia Refinery has three designated cooling water discharges.

NOTE 3: Petro-Canada Inc., Lake Ontario Refinery - Mississauga Plant has two designated once-through cooling water streams.

NOTE 4: Shell Canada Products Limited has two designated once-through cooling water streams. One stream can, on occasion, be mixed with process effluent in the potentially oily water separator.

NOTE 5: Suncor Inc. has one designated once-through cooling water effluent discharge.

NOTE 6: Where there is more than one stream at a refinery:

- the concentration tables represent an average concentration from the individual streams
- the flow and loadings represent the sum of the averages from the individual streams

TABLE C1.0
ONCE-THROUGH COOLING WATER
CONVENTIONAL AND PRIORITY POLLUTANTS FOUND AT
FOUR REFINERIES

PARAMETER	N.	F.O.	MIN	MAX	AVG	UNIT
Hydrogen ion (pH)	799	100	6.400	8.800	7.793	
DOC	149	99	.000	32.700	7.823	mg/L
TOC	224	98	.000	42.000	10.246	mg/L
Total suspended solids	462	86	.000	91.000	9.895	mg/L
Oil and grease	500	78	.000	10.000	2.045	mg/L
Zinc	96	69	.000	90.000	13.431	ug/L
Phenolics (4AAP)	530	68	.000	34.000	2.545	ug/L
Toluene	136	62	.000	66.400	3.583	ug/L
VSS	289	61	.000	54.000	4.248	mg/L
Benzene	143	59	.000	39.230	1.804	ug/L
m-Xylene and p-Xylene	142	58	.000	74.230	2.684	ug/L
o-Xylene	143	50	.000	23.240	1.171	ug/L
Ethylbenzene	143	42	.000	43.390	.897	ug/L
Total phosphorus	55	31	.000	3.200	.124	mg/L
Sulphide	438	20	.000	2.100	.039	mg/L
Ammonia plus Ammonium	418	13	.000	13.000	.095	mg/L
Chromium	96	9	.000	90.000	2.802	ug/L

TABLE C2.1
CONVENTIONAL AND PRIORITY POLLUTANTS FOUND IN OTCW
AT ESSO PETROLEUM CANADA (SARNIA)

PARAMETER	N.	F.O.	MIN	MAX	AVG	UNIT
DOC	36	100	1.000	11.000	4.207	mg/L
Hydrogen ion (pH)	36	100	6.800	8.700	8.250	
TOC	36	100	1.000	10.000	4.585	mg/L
Total suspended solids	36	83	.000	33.400	6.372	mg/L
VSS	36	81	.000	7.500	2.814	mg/L
Toluene	29	76	.000	13.800	2.459	ug/L
Benzene	34	59	.000	7.800	1.284	ug/L
Ammonia plus Ammonium	33	58	.000	.500	.155	mg/L
m-Xylene and p-Xylene	35	43	.000	7.000	1.171	ug/L
o-Xylene	35	37	.000	3.800	.591	ug/L
Ethylbenzene	35	26	.000	2.900	.237	ug/L
Sulphide	36	11	.000	.420	.014	mg/L
Oil and grease	36	8	.000	2.500	.136	mg/L
Phenolics (4AAP)	38	8	.000	7.000	.395	ug/L

N. = number of analyses
F.O. = frequency of detection above the laboratory method detection limit (%)
MIN = minimum concentration
MAX = maximum concentration
AVG = average concentration in 12 months
UNIT = unit of measurement
▒ = conventional pollutant

TABLE C2.2
CONVENTIONAL AND PRIORITY POLLUTANTS FOUND IN
INTAKE WATER AT
ESSO PETROLEUM CANADA (SARNIA)

PARAMETER	N.	F.O.	MIN	MAX	AVG	UNIT
Hydrogen ion (pH)	357	100	7.200	9.100	8.145	
Nitrate+Nitrite	14	100	.230	.380	.291	mg/L
Specific conductance	14	100	207.000	217.000	211.500	uS/cm
TOC	159	99	.000	14.000	4.150	mg/L
Total suspended solids	161	99	.000	48.400	6.995	mg/L
DOC	159	97	.000	13.000	3.344	mg/L
VSS	355	95	.000	41.000	3.632	mg/L
COD	14	93	.000	18.000	8.071	mg/L
Total Kjeldahl nitrogen	14	86	.000	.230	.139	mg/L
Aluminum	14	57	.000	1,000.000	256.571	ug/L
Zinc	14	57	.000	17.000	6.643	ug/L
Methylene chloride	15	53	.000	1.100	.413	ug/L
Toluene	154	47	.000	10.600	.635	ug/L
Arsenic	14	36	.000	2.000	.714	ug/L
Benzene	154	33	.000	8.200	.366	ug/L
Ammonia plus Ammonium	159	23	.000	1.350	.076	mg/L
m-Xylene and p-Xylene	154	20	.000	167.100	1.256	ug/L
Cyanide Total	14	14	.000	31.000	2.217	mg/L
Lead	14	14	.000	50.000	5.714	ug/L
Phenolics (4AAP)	357	14	.000	9.000	.353	ug/L
Total phosphorus	155	14	.000	1.150	.048	mg/L
Oil and grease	160	9	.000	13.000	.240	mg/L
o-Xylene	154	8	.000	63.200	.480	ug/L
Chromium	14	7	.000	35.000	2.500	ug/L
Ethylbenzene	154	5	.000	31.200	.244	ug/L
Sulphide	160	4	.000	.040	.001	mg/L

N. = number of analyses
F.O. = frequency of detection above the laboratory method detection limit (%)
MIN = minimum concentration
MAX = maximum concentration
AVG = average concentration in 12 months
UNIT = unit of measurement
▒▒ = conventional pollutant

TABLE C2.3
CONVENTIONAL AND PRIORITY POLLUTANTS FOUND IN OTCW
AT PETRO-CANADA INC., LAKE ONTARIO REFINERY -
MISSISSAUGA PLANT

PARAMETER	N.	F.O.	MIN	MAX	AVG	UNIT
DOC	28	100	2.700	32.700	9.354	mg/L
Hydrogen ion (pH)	24	100	6.700	8.700	7.629	
TOC	26	100	2.700	36.200	10.631	mg/L
Ammonia plus Ammonium	22	91	.000	13.000	1.236	mg/L
Total suspended solids	24	88	.000	13.500	3.746	mg/L
VSS	24	83	.000	4.100	1.637	mg/L
Zinc	24	83	.000	90.000	22.083	ug/L
Sulphide	24	75	.000	.060	.021	mg/L
Toluene	24	71	.000	5.240	.598	ug/L
m-Xylene and p-Xylene	24	71	.000	3.660	.628	ug/L
o-Xylene	24	67	.000	2.730	.423	ug/L
Oil and grease	24	63	.000	4.500	1.037	mg/L
Benzene	24	58	.000	3.400	.300	ug/L
Ethylbenzene	24	46	.000	.790	.189	ug/L
Chromium	24	17	.000	90.000	5.208	ug/L
Phenolics (4AAP)	26	8	.000	34.000	1.458	ug/L

N. = number of analyses
F.O. = frequency of detection above the laboratory method detection limit (%)
MIN = minimum concentration
MAX = maximum concentration
AVG = average concentration in 12 months
UNIT = unit of measurement
▒▒ = conventional pollutant

TABLE C2.4
CONVENTIONAL AND PRIORITY POLLUTANTS FOUND IN
INTAKE WATER AT
PETRO-CANADA INC., LAKE ONTARIO REFINERY -
MISSISSAUGA PLANT

PARAMETER	N.	F.O.	MIN	MAX	AVG	UNIT
Ammonia plus Ammonium	17	100	.050	36.000	2.203	mg/L
DOC	22	100	1.900	20.900	5.712	mg/L
Hydrogen ion (pH)	23	100	6.500	8.200	7.574	
Nitrate+Nitrite	11	100	.164	.470	.316	mg/L
Specific conductance	11	100	311.000	371.000	328.455	uS/cm
TOC	22	100	.500	25.700	7.814	mg/L
Total suspended solids	23	100	1.500	11.700	4.570	mg/L
Total Kjeldahl nitrogen	11	91	.000	.330	.226	mg/L
VSS	23	91	.000	3.600	1.722	mg/L
Molybdenum	10	90	.000	90.000	30.500	ug/L
Aluminum	10	80	.000	140.000	61.300	ug/L
Nickel	10	70	.000	12.000	3.060	ug/L
Zinc	23	61	.000	116.000	23.522	ug/L
Oil and grease	23	57	.000	2.200	.709	mg/L
COD	11	45	.000	30.000	9.273	mg/L
Vanadium	10	40	.000	9.000	3.000	ug/L
Chromium	24	33	.000	70.000	6.167	ug/L
Sulphide	24	33	.000	.040	.009	mg/L
Arsenic	10	30	.000	1.100	.290	ug/L
Cobalt	10	30	.000	10.000	2.400	ug/L
Selenium	10	30	.000	.700	.190	ug/L
Thallium	10	30	.000	260.000	75.000	ug/L
Phenolics (4AAP)	23	26	.000	5.800	.843	ug/L
Total phosphorus	11	18	.000	.120	.017	mg/L
Benzene	22	14	.000	.150	.019	ug/L
m-Xylene and p-Xylene	22	14	.000	.270	.026	ug/L
Antimony	10	10	.000	.400	.040	ug/L
Copper	10	10	.000	10.000	1.000	ug/L
Silver	10	10	.000	1.000	.100	ug/L
Toluene	22	9	.000	.290	.019	ug/L
Styrene	12	8	.000	3.020	.252	ug/L
o-Xylene	22	5	.000	.170	.008	ug/L

N. = number of analyses
F.O. = frequency of detection above the laboratory method detection limit (%)
MIN = minimum concentration
MAX = maximum concentration
AVG = average concentration in 12 months
UNIT = unit of measurement
Shaded = conventional pollutant

TABLE C2.5
CONVENTIONAL AND PRIORITY POLLUTANTS FOUND IN OTCW
AT SHELL CANADA PRODUCTS LIMITED (SARNIA)

PARAMETER	N.	F.O.	MIN	MAX	AVG	UNIT
Hydrogen ion (pH)	722	100	6.700	8.800	7.774	
DOC	72	99	.000	31.000	10.014	mg/L
TOC	146	97	.000	42.000	12.425	mg/L
Oil and grease	423	85	.000	10.000	2.331	mg/L
Total suspended solids	385	85	.000	91.000	10.881	mg/L
Phenolics (4AAP)	449	76	.000	17.500	2.783	ug/L
m-Xylene and p-Xylene	71	66	.000	74.230	4.368	ug/L
Zinc	72	64	.000	60.000	10.547	ug/L
Toluene	71	58	.000	66.400	5.489	ug/L
Benzene	73	56	.000	39.230	2.605	ug/L
o-Xylene	72	54	.000	23.240	1.815	ug/L
VSS	212	52	.000	54.000	4.939	mg/L
Ethylbenzene	72	51	.000	43.390	1.565	ug/L
Total phosphorus	55	31	.000	3.200	.124	mg/L
Sulphide	363	16	.000	2.100	.044	mg/L
Chromium	72	7	.000	54.000	2.000	ug/L
Ammonia plus Ammonium	363	4	.000	2.960	.021	mg/L

NOTE: The number of analyses is high because two streams were monitored on a frequent basis.

N. = number of analyses
F.O. = frequency of detection above the laboratory method detection limit (%)
MIN = minimum concentration
MAX = maximum concentration
AVG = average concentration in 12 months
UNIT = unit of measurement
▒▒ = conventional pollutant

TABLE C2.6
CONVENTIONAL AND PRIORITY POLLUTANTS FOUND IN
INTAKE WATER AT
SHELL CANADA PRODUCTS LIMITED (SARNIA)

PARAMETER	N.	F.O.	MIN	MAX	AVG	UNIT
Aluminum	12	100	27.000	170.000	90.667	ug/L
Hydrogen ion (pH)	365	100	6.500	8.700	7.628	
Specific conductance	12	100	207.000	738.000	279.583	uS/cm
DOC	21	95	.000	30.000	9.105	mg/L
TOC	65	92	.000	47.000	10.105	mg/L
Nitrate+Nitrite	9	89	.000	.320	.263	mg/L
Total suspended solids	171	80	.000	108.000	11.018	mg/L
Oil and grease	171	79	.000	11.000	2.296	mg/L
COD	12	58	.000	35.000	8.200	mg/L
Copper	12	58	.000	22.000	3.667	ug/L
Total Kjeldahl nitrogen	12	50	.000	.830	.256	mg/L
Phenolics (4AAP)	172	48	.000	9.000	1.408	ug/L
Cobalt	12	42	.000	12.000	3.083	ug/L
VSS	73	36	.000	107.000	3.849	mg/L
Zinc	24	33	.000	40.000	4.625	ug/L
Chloromethane	12	25	.000	8.100	1.742	ug/L
Cyanide Total	12	25	.000	.004	.001	mg/L
Antimony	12	17	.000	11.000	1.500	ug/L
Sulphide	171	15	.000	1.300	.045	mg/L
Total phosphorus	20	15	.000	.360	.030	mg/L
Benzene	24	13	.000	1.837	.133	ug/L
Arsenic	12	8	.000	8.000	.667	ug/L
Chromium	24	8	.000	4.000	.292	ug/L
Di-n-butyl phthalate	12	8	.000	6.300	.525	ug/L
Nickel	12	8	.000	14.000	1.167	ug/L
m-Xylene and p-Xylene	24	8	.000	.940	.069	ug/L
Ammonia plus Ammonium	171	5	.000	.390	.009	mg/L
Toluene	24	4	.000	.580	.024	ug/L

N. = number of analyses
F.O. = frequency of detection above the laboratory method detection limit (%)
MIN = minimum concentration
MAX = maximum concentration
AVG = average concentration in 12 months
UNIT = unit of measurement
= conventional pollutant

TABLE C2.7
CONVENTIONAL AND PRIORITY POLLUTANTS FOUND IN OTCW
AT SUNCOR INC. (SARNIA)

PARAMETER	N.	F.O.	MIN	MAX	AVG	UNIT
DOC	13	100	1.400	3.800	2.408	mg/L
Hydrogen ion (pH)	17	100	6.400	8.300	7.859	
TOC	16	100	.810	4.100	2.482	mg/L
Total suspended solids	17	100	1.000	10.000	3.706	mg/L
VSS	17	94	.000	10.000	2.353	mg/L
Benzene	12	75	.000	6.500	1.417	ug/L
Oil and grease	17	59	.000	1.100	.371	mg/L
Phenolics (4AAP)	17	59	.000	28.000	2.706	ug/L
Sulphide	15	53	.000	.030	.007	mg/L
Toluene	12	33	.000	7.000	.992	ug/L
m-Xylene and p-Xylene	12	33	.000	10.100	1.250	ug/L
Ethylbenzene	12	25	.000	1.300	.225	ug/L
o-Xylene	12	25	.000	4.300	.492	ug/L

N. = number of analyses
F.O. = frequency of detection above the laboratory method detection limit (%)
MIN = minimum concentration
MAX = maximum concentration
AVG = average concentration in 12 months
UNIT = unit of measurement
= conventional pollutant

TABLE C2.8
CONVENTIONAL AND PRIORITY POLLUTANTS FOUND IN
INTAKE WATER AT
SUNCOR INC. (SARNIA)

PARAMETER	N.	F.O.	MIN	MAX	AVG	UNIT
COD	12	100	7.000	20.000	10.000	mg/L
Hydrogen ion (pH)	158	100	6.300	8.600	7.720	
Nitrate+Nitrite	6	100	.140	.310	.232	mg/L
Specific conductance	12	100	328.000	1,330.000	492.167	uS/cm
Total Kjeldahl nitrogen	6	100	.140	.450	.250	mg/L
Total suspended solids	147	100	1.000	52.000	5.660	mg/L
DOC	148	99	.000	20.000	2.518	mg/L
TOC	148	99	.000	39.000	2.930	mg/L
VSS	144	93	.000	10.000	2.444	mg/L
Total phosphorus	147	81	.000	.960	.117	mg/L
Phenolics (4AAP)	147	63	.000	15.000	2.823	ug/L
Ammonia plus Ammonium	145	59	.000	1.900	.251	mg/L
Oil and grease	149	57	.000	10.000	.646	mg/L
1,2-Dichloroethane	12	50	.000	.400	.133	ug/L
Chloromethane	12	42	.000	5.200	1.417	ug/L
Sulphide	147	42	.000	.050	.007	mg/L
Benzene	165	41	.000	16.600	.902	ug/L
Toluene	165	31	.000	8.700	.353	ug/L
Ethylbenzene	165	18	.000	4.600	.124	ug/L
Aluminum	12	17	.000	50.000	7.500	ug/L
Cyanide Total	12	17	.000	.100	.009	mg/L
Methylene chloride	12	17	.000	1.700	.283	ug/L
1,2-Dichloropropane	12	8	.000	.200	.017	ug/L
Copper	12	8	.000	60.000	5.000	ug/L
Pyrene	12	8	.000	.500	.042	ug/L
m-Xylene and p-Xylene	164	5	.000	3.000	.065	ug/L
o-Xylene	165	4	.000	4.600	.055	ug/L

N. = number of analyses
F.O. = frequency of detection above the laboratory method detection limit (%)
MIN = minimum concentration
MAX = maximum concentration
AVG = average concentration in 12 months
UNIT = unit of measurement
▒▒ = conventional pollutant

TABLE C3.0
ONCE-THROUGH COOLING WATER EFFLUENT STREAM
MONTHLY AVERAGE FLOW (m^3/DAY) FOR THE FOUR REFINERIES

MONTH	REFINERY			
	1	2	5	6
DEC 88	181,734	95,030	156,090	83,290
JAN 89	162,226	115,537	148,882	82,822
FEB 89	197,193	100,115	149,678	74,680
MAR 89	89,800	89,850	140,042	73,513
APR 89	185,380	108,586	114,158	69,280
MAY 89	237,604	107,146	139,669	91,340
JUN 89	234,770	120,045	166,088	96,145
JUL 89	177,850	140,742	189,462	103,280
AUG 89	186,894	140,465	204,697	106,833
SEP 89	139,874	149,109	200,145	87,560
OCT 89	(1)	144,830	172,125	81,160
NOV 89	184,093	147,562	131,570	72,950

NOTE (1) - Current records are incorrect. Resubmission is pending.

APPENDIX D

Results on Landfarm Leachate Effluent Streams
(Monitoring Data from December 1, 1988 to November 30, 1989)

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D3.2 Monthly Flow Results for Esso Petroleum Canada, Nanticoke Refinery 53

D4.0 Total Mass Loading for Parameters Calculated at Two Refineries for the Twelve Month Monitoring Period 54

NOTE 1: There are no designated landfarm leachate effluent streams at the other refineries.

NOTE 2: Landfarm leachate at NOVA Petrochemicals Inc. is now treated in their wastewater treatment plant and is not directly discharged. The monitoring data reported are data that were collected prior to the change, on October 18, 1989.

TABLE 01.0
LANDFARM LEACHATE
CONVENTIONAL AND PRIORITY POLLUTANTS FOUND AT
TWO REFINERIES

PARAMETER	N.	F.O.	MIN	MAX	AVG	UNIT
Aluminum	5	100	40.000	480.000	280.000	ug/L
COD	5	100	61.000	100.000	69.800	mg/L
Cyanide Total	5	100	.002	.043	.020	mg/L
DOC	40	100	.000	86.000	32.912	mg/L
Hydrogen ion (pH)	43	100	6.700	8.500	7.276	
Molybdenum	5	100	9.000	140.000	89.800	ug/L
Nitrate+Nitrite	5	100	.780	49.100	21.836	mg/L
Specific conductance	5	100	1,390.000	2,060.000	1,664.000	uS/cm
TOC	18	100	.000	91.000	38.250	mg/L
Total Kjeldahl nitrogen	5	100	1.500	2.400	2.026	mg/L
Total suspended solids	44	100	2.800	138.000	22.136	mg/L
Zinc	7	100	.000	140.000	60.286	ug/L
VSS	43	93	.000	26.000	4.691	mg/L
Ammonia plus Ammonium	41	88	.000	1.780	.353	mg/L
Phenolics (4AAP)	42	81	.000	15.000	4.976	ug/L
Copper	5	80	.000	10.000	5.000	ug/L
Vanadium	5	80	.000	20.000	12.200	ug/L
Sulphide	43	79	.000	.200	.044	mg/L
Oil and grease	43	77	.000	9.000	2.747	mg/L
Chromium (hexavalent)	4	75	.000	10.000	5.750	ug/L
Methylene chloride	3	67	.000	7.100	4.233	ug/L
Cadmium	5	60	.000	.200	.120	ug/L
Lead	5	60	.000	6.000	2.600	ug/L
Nickel	5	60	.000	20.000	10.000	ug/L
1,2,4-Trichlorobenzene	4	50	.000	.052	.022	ug/L
2,4,5-Trichlorotoluene	4	50	.000	.006	.003	ug/L
Hexachlorobutadiene	4	50	.000	.009	.003	ug/L
Pentachlorobenzene	4	50	.000	.025	.011	ug/L
Total phosphorus	43	44	.000	1.600	.139	mg/L
Chromium	7	43	.000	20.000	8.571	ug/L
4-Nitrophenol	5	40	.000	20.000	7.900	ug/L
5-nitro, Acenaphthene	5	40	.000	1.400	.520	ug/L
Acrolein	5	40	.000	5.900	2.220	ug/L
Cobalt	5	40	.000	20.000	8.000	ug/L
Di-n-butyl phthalate	5	40	.000	3.100	1.140	ug/L
Selenium	5	40	.000	1.000	.400	ug/L
Thallium	5	40	.000	80.000	32.000	ug/L
Benzene	40	25	.000	.520	.076	ug/L
Octachlorostyrene	4	25	.000	.006	.001	ug/L
Benzylbutylphthalate	5	20	.000	1.500	.300	ug/L
Bis(2-ethylhexyl) phthalate	5	20	.000	6.800	1.360	ug/L
Chloroform	5	20	.000	.630	.126	ug/L
Chloromethane	5	20	.000	2.700	.540	ug/L
Ethylbenzene	40	20	.000	.110	.009	ug/L
Fluoranthene	5	20	.000	3.900	.780	ug/L
Mercury	5	20	.000	.050	.010	ug/L
Trichlorofluoromethane	5	20	.000	1.040	.208	ug/L
o-Xylene	40	20	.000	.240	.021	ug/L
Toluene	40	18	.000	1.300	.071	ug/L
m-Xylene and p-Xylene	40	10	.000	.260	.018	ug/L

N. = number of analyses
F.O. = frequency of detection above the laboratory method detection limit (%)
MIN = minimum concentration
MAX = maximum concentration
AVG = average concentration in 12 months
UNIT = unit of measurement
= conventional pollutant

TABLE D2.1
LANDFARM LEACHATE
CONVENTIONAL AND PRIORITY POLLUTANTS FOUND AT
NOVA PETROCHEMICALS INC. (CORUNNA)

PARAMETER	N.	F.O.	MIN	MAX	AVG	UNIT
Aluminum	1	100	40.000	40.000	40.000	ug/L
Benzylbutylphthalate	1	100	1.500	1.500	1.500	ug/L
COD	1	100	61.000	61.000	61.000	mg/L
Cyanide Total	1	100	.003	.003	.003	mg/L
DOC	7	100	12.000	48.000	35.857	mg/L
Hydrogen ion (pH)	7	100	7.150	8.500	7.850	
Molybdenum	1	100	9.000	9.000	9.000	ug/L
Nitrate+Nitrite	1	100	16.000	16.000	16.000	mg/L
Phenolics (4AAP)	6	100	2.000	14.000	5.833	ug/L
Specific conductance	1	100	1,420.000	1,420.000	1,420.000	uS/cm
TOC	6	100	26.000	59.000	44.833	mg/L
Total Kjeldahl nitrogen	1	100	1.500	1.500	1.500	mg/L
Total suspended solids	7	100	3.000	17.000	7.571	mg/L
Vanadium	1	100	11.000	11.000	11.000	ug/L
Zinc	3	100	2.000	40.000	24.000	ug/L
Sulphide	7	71	.000	.110	.041	mg/L
Ammonia plus Ammonium	7	57	.000	1.200	.356	mg/L
VSS	7	57	.000	10.000	3.429	mg/L
Oil and grease	7	29	.000	8.000	1.957	mg/L

N. = number of analyses
F.O. = frequency of detection above the laboratory method detection limit (%)
MIN = minimum concentration
MAX = maximum concentration
AVG = average concentration in 12 months
UNIT = unit of measurement
▒▒ = conventional pollutant

TABLE D2.2
LANDFARM LEACHATE
CONVENTIONAL AND PRIORITY POLLUTANTS FOUND AT
ESSO PETROLEUM CANADA (NANTICOKE)

PARAMETER	N.	F.O.	MIN	MAX	AVG	UNIT
Aluminum	4	100	180.000	480.000	340.000	ug/L
COD	4	100	61.000	100.000	72.000	mg/L
Copper	4	100	5.000	10.000	6.250	ug/L
Cyanide Total	4	100	.002	.043	.024	mg/L
DOC	33	100	.000	86.000	32.288	mg/L
Hydrogen ion (pH)	36	100	6.700	7.900	7.164	
Methylene chloride	2	100	5.600	7.100	6.350	ug/L
Molybdenum	4	100	60.000	140.000	110.000	ug/L
Nitrate+Nitrite	4	100	.780	49.100	23.295	mg/L
Specific conductance	4	100	1,390.000	2,060.000	1,725.000	uS/cm
TOC	12	100	.000	91.000	34.958	mg/L
Total Kjeldahl nitrogen	4	100	1.630	2.400	2.158	mg/L
Total suspended solids	37	100	2.800	138.000	24.892	mg/L
VSS	36	100	.800	26.000	4.936	mg/L
Zinc	4	100	.000	140.000	87.500	ug/L
Ammonia plus Ammonium	34	94	.000	1.780	.352	mg/L
Oil and grease	36	86	.000	9.000	2.900	mg/L
Sulphide	36	81	.000	.200	.044	mg/L
Phenolics (4AAP)	36	78	.000	15.000	4.833	ug/L
Cadmium	4	75	.000	.200	.150	ug/L
Chromium	4	75	.000	20.000	15.000	ug/L
Chromium (hexavalent)	4	75	.000	10.000	5.750	ug/L
Lead	4	75	.000	6.000	3.250	ug/L
Nickel	4	75	.000	20.000	12.500	ug/L
Vanadium	4	75	.000	20.000	12.500	ug/L
Total phosphorus	36	53	.000	1.600	.166	mg/L
1,2,4-Trichlorobenzene	4	50	.000	.052	.022	ug/L
2,4,5-Trichlorotoluene	4	50	.000	.006	.003	ug/L
4-Nitrophenol	4	50	.000	20.000	9.875	ug/L
5-nitro, Acenaphthene	4	50	.000	1.400	.650	ug/L
Acrolein	4	50	.000	5.900	2.775	ug/L
Cobalt	4	50	.000	20.000	10.000	ug/L
Di-n-butyl phthalate	4	50	.000	3.100	1.425	ug/L
Hexachlorobutadiene	4	50	.000	.009	.003	ug/L
Pentachlorobenzene	4	50	.000	.025	.011	ug/L
Selenium	4	50	.000	1.000	.500	ug/L
Thallium	4	50	.000	80.000	40.000	ug/L
Benzene	31	32	.000	.520	.098	ug/L
Ethylbenzene	31	26	.000	.110	.011	ug/L
o-Xylene	31	26	.000	.240	.028	ug/L
Bis(2-ethylhexyl) phthalate	4	25	.000	6.800	1.700	ug/L
Chloroform	4	25	.000	.630	.158	ug/L
Chloromethane	4	25	.000	2.700	.675	ug/L
Fluoranthene	4	25	.000	3.900	.975	ug/L
Mercury	4	25	.000	.050	.013	ug/L
Octachlorostyrene	4	25	.000	.006	.001	ug/L
Trichlorofluoromethane	4	25	.000	1.040	.260	ug/L
Toluene	31	23	.000	1.300	.092	ug/L
m-Xylene and p-Xylene	31	13	.000	.260	.023	ug/L

N. = number of analyses
F.O. = frequency of detection above the laboratory method detection limit (%)
MIN = minimum concentration
MAX = maximum concentration
AVG = average concentration in 12 months
UNIT = unit of measurement
= conventional pollutant

TABLE D3.1*
LANDFARM LEACHATE
MONTHLY FLOW RESULTS FOR
NOVA PETROCHEMICALS INC. (CORUNNA)

MONTH	TOTAL VOLUME DISCHARGED (cu. meters)	TOTAL DISCHARGE DURATION (hours)
FEB 89	568.000	5.000
MAR 89	1,661.000	16.000
APR 89	1,310.000	10.000
MAY 89	541.000	5.000

TABLE D3.2*
LANDFARM LEACHATE
MONTHLY FLOW RESULTS FOR
ESSO PETROLEUM CANADA (NANTICOKE)

MONTH	TOTAL VOLUME DISCHARGED (cu. meters)	TOTAL DISCHARGE DURATION (hours)
DEC 88	5.800	0.167
JAN 89	59.300	76.000
APR 89	1,156.000	30.000
SEP 89	4,539.000	118.750
OCT 89	1,675.000	48.500
NOV 89	4,566.000	148.500

* Results are presented for the months in which discharge events occurred.

TABLE D4.0
LANDFARM LEACHATE
TOTAL MASS LOADING (KG) FOR PARAMETERS
CALCULATED AT TWO REFINERIES
FOR THE TWELVE MONTH MONITORING PERIOD

Parameter	REFINERY	
	4	7
4-Nitrophenol	(1)	.02
Aluminum	(1)	.52
Ammonia plus Ammonium	.99	2.33
COD	(1)	72.83
Chromium	(1)	.02
Chromium (hexavalent)	(1)	.01
Cobalt	(1)	.02
Copper	(1)	.01
Cyanide Total	(1)	.05
DOC	146.43	639.07
Molybdenum	(1)	.16
Nickel	(1)	.02
Nitrate+Nitrite	(1)	50.98
Oil and grease	5.24	46.29
Phenolics (4AAP)	.03	.10
Sulphide	.17	.61
TOC	180.90	305.09
Thallium	(1)	.09
Total Kjeldahl nitrogen	(1)	2.66
Total phosphorus	(1)	2.74
Total suspended solids	34.06	443.41
VSS	17.48	97.37
Vanadium	(1)	.02
Zinc	.06	.09

NOTE (1) - Although sample records exist for the parameter, there are no corresponding discharge data or the sample values are less than the laboratory method detection limit.

= conventional pollutant

APPENDIX E

Results on Storm Water Effluent Streams
(Monitoring Data from December 1, 1988 to November 30, 1989)

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NOTE 1: There is no designated storm water discharge at Esso Petroleum Canada, Sarnia Refinery or Suncor Inc.

NOTE 2: Although there are designated storm water effluent discharge points at Petro-Canada Inc., Lake Ontario Refinery - Mississauga Plant and the Oakville Plant there were no discharges over the monitoring period since the storm water was treated through the biotreater.

NOTE 3: There are three storm water discharges at Shell Canada Products Limited. Table E2.2 represents the average concentration from the three storm water streams. Table E3.2 (flow results) represents total volume discharged from all three streams over the twelve month monitoring period. Table E4.0 (mass loading) is the total mass loadings from all three streams over the twelve month monitoring period. The loading was calculated by multiplying the total volume discharged in a month by the average monthly concentration for each individual stream.

TABLE E1.0
STORM WATER EFFLUENT STREAMS
CONVENTIONAL AND PRIORITY POLLUTANTS FOUND AT
THREE REFINERIES

PARAMETER	N.	F.O.	MIN	MAX	AVG	UNIT
DOC	157	100	1.600	51.000	8.415	mg/L
Hydrogen ion (pH)	240	100	5.300	9.300	7.814	
TOC	113	100	1.600	61.000	12.630	mg/L
Total suspended solids	241	98	.000	333.000	43.212	mg/L
Zinc	55	96	.000	1,800.000	192.178	ug/L
VSS	241	82	.000	64.000	6.856	mg/L
Phenolics (4AAP)	234	69	.000	25.000	3.819	ug/L
Oil and grease	241	67	.000	8.300	1.778	mg/L
Total phosphorus	166	67	.000	6.310	.215	mg/L
Sulphide	167	62	.000	.710	.055	mg/L
Ammonia plus Ammonium	229	60	.000	20.800	.317	mg/L
o-Xylene	154	20	.000	233.680	2.212	ug/L
Toluene	153	18	.000	29.141	.672	ug/L
Benzene	153	16	.000	64.990	.645	ug/L
Chromium	58	16	.000	540.000	23.793	ug/L
m-Xylene and p-Xylene	153	16	.000	85.520	1.329	ug/L
Ethylbenzene	155	10	.000	26.890	.285	ug/L

TABLE E2.1
STORM WATER EFFLUENT STREAM
CONVENTIONAL AND PRIORITY POLLUTANTS FOUND AT
NOVA PETROCHEMICALS INC. (CORUNNA)

PARAMETER	N.	F.O.	MIN	MAX	AVG	UNIT
DOC	25	100	4.000	17.000	9.400	mg/L
Hydrogen ion (pH)	27	100	7.700	8.500	8.067	
TOC	25	100	5.000	24.000	11.920	mg/L
Total suspended solids	27	100	8.000	333.000	56.111	mg/L
Zinc	2	100	170.000	220.000	195.000	ug/L
VSS	27	96	.000	64.000	8.604	mg/L
Sulphide	28	93	.000	.710	.119	mg/L
Total phosphorus	27	67	.000	.360	.066	mg/L
Phenolics (4AAP)	27	63	.000	25.000	4.741	ug/L
Ammonia plus Ammonium	26	62	.000	.240	.099	mg/L
Oil and grease	27	26	.000	7.000	1.000	mg/L
Chromium	5	20	.000	80.000	16.000	ug/L
m-Xylene and p-Xylene	30	7	.000	2.000	.102	ug/L
Ethylbenzene	30	3	.000	.720	.024	ug/L
o-Xylene	30	3	.000	3.680	.123	ug/L

N. = number of analyses
F.O. = frequency of detection above the laboratory method detection limit (%)
MIN = minimum concentration
MAX = maximum concentration
AVG = concentration in 12 months
UNIT = unit of measurement
▒▒ = conventional pollutant

TABLE E2.2
STORM WATER EFFLUENT STREAMS
CONVENTIONAL AND PRIORITY POLLUTANTS FOUND AT
SHELL CANADA PRODUCTS LIMITED (SARNIA)

PARAMETER	N.	F.O.	MIN	MAX	AVG	UNIT
DOC	53	100	3.000	51.000	14.132	mg/L
Hydrogen ion (pH)	128	100	5.300	9.300	7.705	
TOC	54	100	5.000	61.000	18.648	mg/L
Total suspended solids	129	97	.000	331.000	38.310	mg/L
Zinc	53	96	.000	1,800.000	192.072	ug/L
Phenolics (4AAP)	122	83	.000	20.000	4.890	ug/L
Oil and grease	129	80	.000	8.000	2.092	mg/L
VSS	129	70	.000	40.000	8.194	mg/L
Total phosphorus	54	65	.000	6.310	.340	mg/L
Ammonia plus Ammonium	118	46	.000	20.800	.527	mg/L
Toluene	50	36	.000	29.141	1.969	ug/L
m-Xylene and p-Xylene	50	32	.000	85.520	3.982	ug/L
o-Xylene	51	27	.000	233.680	6.565	ug/L
Benzene	50	22	.000	64.990	1.864	ug/L
Sulphide	54	19	.000	.320	.031	mg/L
Chromium	53	15	.000	540.000	24.528	ug/L
Ethylbenzene	52	13	.000	26.890	.829	ug/L

TABLE E2.3
STORM WATER EFFLUENT STREAM
CONVENTIONAL AND PRIORITY POLLUTANTS FOUND AT
ESSO PETROLEUM CANADA (NANTICOKE)

PARAMETER	N.	F.O.	MIN	MAX	AVG	UNIT
DOC	79	100	1.600	40.000	4.268	mg/L
Hydrogen ion (pH)	85	100	6.900	8.900	7.899	
TOC	34	100	1.600	26.000	3.594	mg/L
Total suspended solids	85	100	2.800	308.000	46.553	mg/L
VSS	85	96	.000	14.000	4.269	mg/L
Ammonia plus Ammonium	85	79	.000	.840	.092	mg/L
Sulphide	85	79	.000	.520	.050	mg/L
Total phosphorus	85	69	.000	.800	.182	mg/L
Oil and grease	85	60	.000	8.300	1.547	mg/L
Phenolics (4AAP)	85	51	.000	10.000	1.988	ug/L
o-Xylene	73	22	.000	.550	.030	ug/L
Benzene	73	18	.000	1.870	.075	ug/L
Toluene	73	12	.000	.940	.060	ug/L
Ethylbenzene	73	10	.000	.110	.004	ug/L
m-Xylene and p-Xylene	73	8	.000	.360	.016	ug/L

N. = number of analyses
F.O. = frequency of detection above the laboratory method detection limit (%)
MIN = minimum concentration
MAX = maximum concentration
AVG = average concentration in 12 months
UNIT = unit of measurement
= conventional pollutant

TABLE E3.1*
STORM WATER EFFLUENT STREAM
MONTHLY FLOW RESULTS FOR
NOVA PETROCHEMICALS INC. (CORUNNA)

MONTH	TOTAL VOLUME DISCHARGED (cu. meters)	TOTAL DISCHARGE DURATION (hours)
JAN 89	45,198.000	152.000
FEB 89	6,019.000	21.000
MAR 89	125,449.000	149.000
APR 89	36,119.000	109.000
MAY 89	63,483.000	78.000
JUN 89	61,477.000	100.000
JUL 89	42,132.000	11.000
AUG 89	2,990.000	3.000
SEP 89	17,338.000	84.000
OCT 89	23,697.000	26.000
NOV 89	56,403.000	80.000

TABLE E3.2*
STORM WATER EFFLUENT STREAMS
MONTHLY FLOW RESULTS FOR
SHELL CANADA PRODUCTS LIMITED (SARNIA)

MONTH	TOTAL VOLUME DISCHARGED (cu. meters)	TOTAL DISCHARGE DURATION (hours)
DEC 88	52,826.000	115.000
JAN 89	10,936.000	29.50
FEB 89	19,177.000	31.000
MAR 89	42,034.000	68.000
APR 89	1,165.000	4.670
MAY 89	10,860.500	29.500
JUN 89	46,951.000	76.250
JUL 89	40,436.000	61.650
AUG 89	22,351.000	39.000
SEP 89	57,871.400	123.250
OCT 89	34,815.000	55.700
NOV 89	60,551.000	98.550

* Results are presented for the months in which discharge events occurred.

TABLE E3.3*
STORM WATER EFFLUENT STREAM
MONTHLY FLOW RESULTS FOR
ESSO PETROLEUM CANADA (NANTICOKE)

MONTH	TOTAL VOLUME DISCHARGED (cu. meters)	TOTAL DISCHARGE DURATION (hours)
DEC 88	19,431.000	60.000
JAN 89	15,500.900	39.000
FEB 89	13,482.000	23.000
MAR 89	56,807.000	83.000
APR 89	102,098.000	59.250
MAY 89	17,466.000	19.500
JUN 89	41,610.000	59.250
JUL 89	12,493.000	14.250
AUG 89	57,911.000	61.250
SEP 89	65,362.000	79.500
OCT 89	19,917.000	29.500
NOV 89	133,584.000	127.000

TABLE E4.0
STORM WATER EFFLUENT STREAMS
TOTAL MASS LOADING (KG) FOR PARAMETERS
CALCULATED AT THREE REFINERIES
FOR THE TWELVE MONTH PERIOD

Parameter	REFINERY		
	4	5	7
Ammonia plus Ammonium	46.25	192.41	44.22
Benzene	(1)	.26	.05
Chromium	3.35	2.75	(1)
DOC	4,665.65	5,781.38	2,108.58
Ethylbenzene	.02	.48	(1)
Oil and grease	567.70	1,108.92	856.85
Phenolics (4AAP)	2.20	2.37	1.15
Sulphide	54.72	12.20	33.04
TOC	6,276.91	7,824.13	1,517.18
Toluene	(1)	.87	.03
Total phosphorus	38.92	146.72	108.76
Total suspended solids	24,953.58	16,267.16	29,038.66
VSS	4,103.95	3,333.60	2,514.81
Zinc	24.46	(2)	(1)
m-Xylene and p-Xylene	.06	2.10	.01
o-Xylene	.06	3.55	.01

* Results are presented for the months in which discharge events occurred.

NOTE (1) - Either sample values are less than laboratory method detection limit or sample records for the parameter do not exist.

NOTE (2) - Resubmission is pending.

= conventional pollutant

APPENDIX F

Results on Emergency Overflow Effluent Streams
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NOTE 1: There are no designated emergency overflow effluent streams at Petro-Canada Inc., Lake Ontario Refinery - Mississauga Plant, Suncor Inc, NOVA Petrochemicals Inc, and Shell Canada Products Limited.

NOTE 2: Although there is a designated emergency overflow effluent stream at Petro-Canada Inc., Lake Ontario Refinery - Oakville Plant, there was no discharge during the monitoring period.

NOTE 3: There are seven designated emergency overflow effluent streams at Esso Petroleum Canada, Sarnia Refinery of which two had discharges but data are available for only one event.

NOTE 4: A monthly flow results and total mass loading table for Esso Petroleum Canada, Nanticoke Refinery is not presented because existing sample records contain questionable results.

TABLE F1.0
EMERGENCY OVERFLOW
CONVENTIONAL AND PRIORITY POLLUTANTS FOUND AT
TWO REFINERIES

PARAMETER	N.	F.O.	MIN	MAX	AVG	UNIT
Benzene	2	100	1.220	1,133.000	567.110	ug/L
DOC	2	100	23.000	52.000	37.500	mg/L
Hydrogen ion (pH)	2	100	7.300	8.200	7.750	
Oil and grease	2	100	4.200	38.600	21.400	mg/L
Phenolics (4AAP)	2	100	4.000	56.000	30.000	ug/L
TOC	2	100	37.000	58.000	47.500	mg/L
Total suspended solids	2	100	31.600	212.600	122.100	mg/L
VSS	1	100	8.400	8.400	8.400	mg/L
Sulphide	2	50	.000	.030	.015	mg/L
Toluene	2	50	.000	3,034.000	1,517.000	ug/L

TABLE F2.1
EMERGENCY OVERFLOW
CONVENTIONAL AND PRIORITY POLLUTANTS FOUND AT
ESSO PETROLEUM CANADA (SARNIA)

PARAMETER	N.	F.O.	MIN	MAX	AVG	UNIT
Benzene	1	100	1,133.000	1,133.000	1,133.000	ug/L
DOC	1	100	23.000	23.000	23.000	mg/L
Hydrogen ion (pH)	1	100	8.200	8.200	8.200	
Oil and grease	1	100	38.600	38.600	38.600	mg/L
Phenolics (4AAP)	1	100	56.000	56.000	56.000	ug/L
TOC	1	100	37.000	37.000	37.000	mg/L
Toluene	1	100	3,034.000	3,034.000	3,034.000	ug/L
Total suspended solids	1	100	212.600	212.600	212.600	mg/L

TABLE F2.2
EMERGENCY OVERFLOW
CONVENTIONAL AND PRIORITY POLLUTANTS FOUND AT
ESSO PETROLEUM CANADA (NANTICOKE)

PARAMETER	N.	F.O.	MIN	MAX	AVG	UNIT
Benzene	1	100	1.220	1.220	1.220	ug/L
DOC	1	100	52.000	52.000	52.000	mg/L
Hydrogen ion (pH)	1	100	7.300	7.300	7.300	
Oil and grease	1	100	4.200	4.200	4.200	mg/L
Phenolics (4AAP)	1	100	4.000	4.000	4.000	ug/L
Sulphide	1	100	.030	.030	.030	mg/L
TOC	1	100	58.000	58.000	58.000	mg/L
Total suspended solids	1	100	31.600	31.600	31.600	mg/L
VSS	1	100	8.400	8.400	8.400	mg/L

N. = number of analyses
F.O. = frequency of detection above the laboratory method detection limit (%)
MIN = minimum concentration
MAX = maximum concentration
AVG = average concentration in 12 months
UNIT = unit of measurement
▒▒ = conventional pollutant

TABLE F3.1*
EMERGENCY OVERFLOW
MONTHLY FLOW RESULTS FOR
ESSO PETROLEUM CANADA (SARNIA)

MONTH	TOTAL VOLUME DISCHARGED (cu. meters)	TOTAL DISCHARGE DURATION (hours)
JAN 89	159.000	.250
JUL 89	23.800	1.000

* Results are presented for the months in which discharge events occurred.

TABLE F4.0
EMERGENCY OVERFLOW
TOTAL MASS LOADING (KG) FOR PARAMETERS
CALCULATED AT ONE REFINERY
FOR THE TWELVE MONTH PERIOD

PARAMETER	REFINERY 1
Benzene	.03
DOC	.55
Oil and grease	.92
TOC	.88
Toluene	.07
Total suspended solids	5.06

= conventional pollutant